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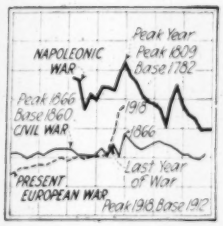
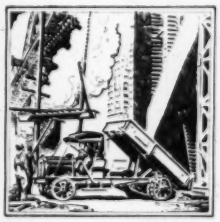


THE PRICE SITUATION is the one unfailing topic in the field of engineering today. Until recently there was widespread conviction that prices would fall rapidly and by a large percentage. Fuller study is leading to the conviction that recessions will not be large. This view is held by Morris Knowles, who reviews in this issue the price trends following the Napoleonic and Civil Wars. His study sheds light on a difficult and necessarily indefinite problem.



ANOTHER TOPIC of deep interest now is the cost of motor trucking. Accurate figures are difficult to secure. In fact, it is doubtful whether reliable ton-mile data are yet available; but until we get them operating costs per day are of help. They enable us to discover the principal inefficiencies and the directions in which economies may be effected. Some figures that should excite discussion among truck operators and those whose clients pay the bills will be found in a brief article in this issue.

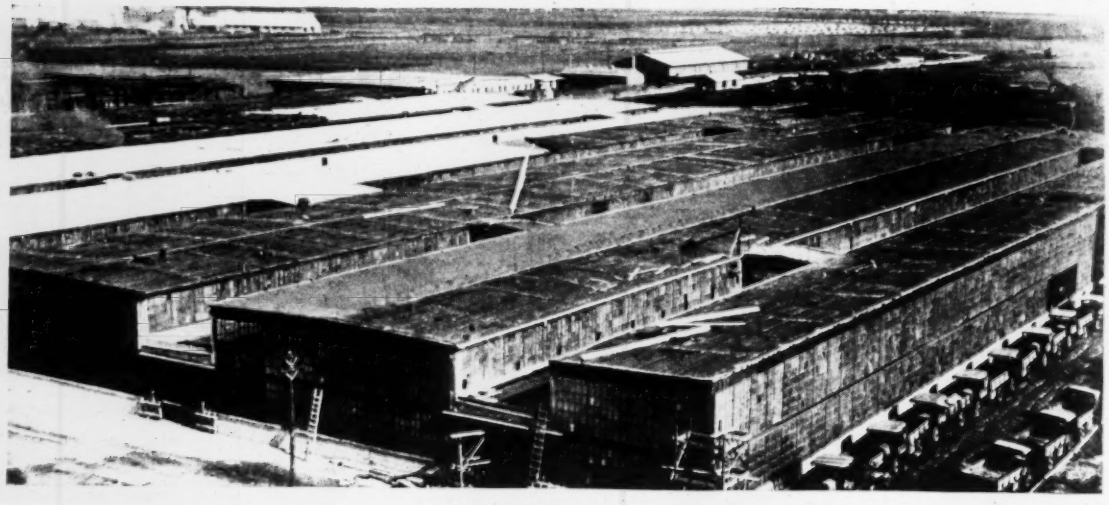
Also in this issue:

TESTS SHOW HIGH SHEAR IN DEEP CONCRETE BEAMS
By W. A. SLATER

OPERATING A HYDRAULIC DREDGE UNDER DIFFICULTIES
By ALBERT S. FRY

COMPARISON OF EXISTING AND PROPOSED LAWS FOR LICENSING ENGINEERS

Uncle Sam Chooses Federal Channel Tile For Motor Truck Repair Units



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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, Consulting Editor

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Scientific Advance of the Irrigation Art

IRRIGATION as an art guided by science is progressing. Week before last we published an article giving some of the results of a series of studies on seepage and the duty of water. It appears from a very practical article on algæ removal from irrigation canals, printed last week on p. 382, that scientific observations were made on the kinds of algæ which caused the trouble dealt with. Moreover, one reason why it was necessary to reduce algæ was because they clogged the meters which have been installed on this particular project. Certainly, the science of irrigation is progressing when water for crops is sold by meter measurement and an attack against algæ is directed with the aid of the microscope.

Concrete Shear Tests Should Be Continued

IN SPITE of a number of tests, most of them of long standing, knowledge of shear in concrete is in a most unsatisfactory state. There seems to be little doubt that existing permissible safe values are much too low and that in some kinds of design, particularly in deep beams, this restriction operates with considerable hardship. The series of tests inaugurated for the Emergency Fleet Corporation by the Bureau of Standards, some of which are described by Mr. Slater on another page, went far enough to promise valuable results, not only in the matter of shear, but also in many other properties of concrete. Unfortunately, however, they cannot be continued under the same auspices. The Bureau of Standards is willing and anxious to take up certain lines of this work where it was left off, but it lacks sufficient funds to continue the investigation. It would be shortsighted policy on the part of Congress to refuse the few thousand dollars that are necessary for this work, which, if continued as already begun, should result in a great saving in concrete design. Technical societies and individual engineers might well interest themselves to the extent of writing to their Congressmen urging the necessary expenditure.

Problems of the Profession and the Local Association

FOR some years the movement toward local grouping of engineers has been progressing more or less, under the impetus of the natural need for such grouping, as well as through the efforts of men who saw the importance of this development for the expression of professional interest. The larger national societies have made various advances in local organization, the Engineering Council is studying the matter, and in addition a new association formed essentially as a focus of local groups has come into being. There is a healthy competition between these directive agencies of local organizations which promises well for the progress of the movement. On the subject of the pressing need for active local organizations, independent of the means employed, such comments on the needs of engineers as Mr. Finley's, represented by the extracts on p. 363 of last week's issue, address themselves to all engineers without regard to affiliation. The separated extracts we reproduced, culled from an informal speech, are not to be judged as forming a logical exposition of the profession's situation. They do, however, center unmistakably on the question of better organizing the profession, and point toward the dual purpose of helping the engineer and of enabling the engineer to help the public—his community. Those who know the problems of professional existence and who have learned by their own bitter experience the need for applying the engineering mind to public matters more than has been done in the past will value Mr. Finley's message.

How to Get Local Publicity

RARELY if ever has any engineering society been so lavishly treated by newspapers as to have from five to nine columns per day given up to its papers and meetings, in addition to having the news syndicated and sent to all newspapers of the state. Yet this was done last week by the Muscatine *Journal* during the two-day annual meeting of the Iowa Engineering Society. For six consecutive days previous to the meeting half-column articles about the meeting appeared, and a welcoming editorial contained these significant words: "Reconstruction is the vital responsibility which faces the nation today. Here the engineer is peculiarly qualified to assume a leadership. We must look to the engineer for leadership in the important national and communal projects which contemplate an extension of the opportunities of service." This was the news-peg on which much of the publicity hung. Back of this almost unbelievable result lies a story of a publicity campaign that every engineering society should take to heart. A central committee was coached by an old newspaper editor who handed out simple, usable rules, taking the mystery out of publicity. News-pegs, the importance of strong introductory paragraphs, and other "first aids" to the engineers in publicity, were explained to the committee. It is important to note that this committee then proceeded to bring its influence to bear on the local en-

gineers, not directly on the editor, to whom the members of the committee were total strangers. In the last analysis actual flesh-and-blood contact must be made. The more human it is the better the result. It is said that a certain Muscatine engineer got the better of the editor in a recent fishing contest; at least, it is certain that they go fishing together and know the best holes. Engineering publicity in that city becomes therefore only a question of producing articles, for an understanding has already been reached. The problem of getting engineering publicity in Iowa is well on the way toward solution, and the immediate undertaking, a sustained publicity campaign on the engineers' registration bill, should energize the local engineers into action, thus making a vital link in the publicity chain heretofore largely neglected.

Civilians Did Army's Construction Work in the United States

THIS entire country—and, indeed, all countries participating in the world war—took a keen interest in the performance of the group of men who so speedily built the 32 training camps for the United States Army. The rapid growth of these camps was spectacular and made a deep public impression, but full explanation has never been widely circulated that it was the civilian engineers and contractors of the nation, rather than a regular Army organization, which accomplished this modern miracle. Undoubtedly, it was one of the notable achievements of our military establishment and one of the substantial factors in the winning of the war. As the construction of these camps at a cost of $200,000,000 approached completion, it was preëminently wise for the War Department to have placed, as it did, all subsequent work for the Army in the United States in the hands of the Construction Division.

An account of the wide scope of work, representing about $1,000,000,000, undertaken during the year and ending with the armistice, is given on p. 416. It comes from an engineer who has been one of the Construction Division's technical advisers since the early days of the war, and who has had even better opportunities to view the work as a whole than those closely engaged in the various parts of the program. Not only does the kind and amount of this work interest engineers, but the type of the organization furnishes in particular a just source of pride to civilian engineers. It is significant that there were not more than three regular Army officers connected at any time with the organization—barely enough to guide the huge performances in conformity with Army regulations. Whether or not the men who "did their bit" so effectively wore the uniform of the Army matters not—the outstanding feature of it all is that the rich, practical experience of over a hundred of the most active engineering and contracting concerns in the country was embodied in the organization.

By the untiring, skillful, devoted work of these engineers and contractors, in city, village and wilderness, all over the United States, there arose, as though by magic, camps, munition plants and warehouses. The work of the civilian engineers set free the all-too-few military engineers to win laurels on the fighting fronts of France, the place of their heart's desire. It should always be remembered with gratitude that those who remained in America, in the Construction Division and on other assignments, also served their country.

Internal Fissures in Steel

ANOTHER step forward has been made in our knowledge of steel through the study of "snowflakes" discussed at last week's meeting of the American Institute of Mining Engineers. The new knowledge is, like numerous other items of scientific and practical progress, a byproduct of war activities.

Flakes, interior defects that show as white, rough-textured patches on the fracture, and that apparently destroy the ductility of the metal, occurred with such frequency in the production of shell and cannon steel during the past year or two that, for a time at least, they were almost an epidemic disease. They affected alloy steels, chiefly nickel steel, and in some instances they led to serious failures of machine parts made of this material. But there are reasons for thinking that causes similar to those responsible for flakes in nickel steel may account for some unexplained troubles of much more widely used grades of steel.

Studies at the Bureau of Standards by H. S. Rawdon demonstrated flakes to be minute internal cracks or fissures in the steel. Various facts revealed by the microscope showed that these cracks originated at the time the metal was in the ingot, and probably were due to ingot peculiarities. However, other facts, brought out in discussion, suggested that snowflakes may also be produced at later stages in the history of a piece. It appears that the mechanical or thermal treatment of the metal at a time when it is going through a structural change which makes it temporarily weak is responsible for producing the minute cracks. The question of how flakes originate is by no means fully cleared, but enough has been accomplished to assure further progress. It is within reason to conclude that the facts now being accumulated will lead to methods of preventing or avoiding flake trouble.

So far as yet appears, these flakes concern only metal of the highly special grades used for crankshafts and for guns. But there is the prospect that the studies made have direct bearing on the quality of steel railway rails, and if this should prove true it will give the snowflake question a far wider interest, and probably constitute its main importance. If the most dangerous and elusive defect of rails, the transverse-fissure defect, can be brought under control, railway safety will be increased.

For six or seven years the transverse fissure has been the leading problem in rails. It is a particularly dangerous defect because it does not reveal itself until the rail has broken. Despite extensive investigation and no end of discussion, nobody has yet succeeded in finding what starts transverse fissures, though it seems certain that some local deficiency of quality must have existed at the nucleus of the slowly growing detail fracture which characterizes the transverse fissure.

Microscopic and chemical studies of all kinds failed to show any condition at the nucleus of transverse fissure different from the conditions in the normal rail

metal. Now, however, the snowflake of gun steel, and the discovery that a microscopic crack is responsible for it, throws sudden light on the nature of the transverse-fissure defect. M. H. Wickhorst, who has been studying rail defects for some years in the interests of the American Railway Association, identifies the two defects as strikingly similar and quite probably the same. Careful research will be needed to establish the identification with certainty; nevertheless, it unquestionably supplies for the present a working hypothesis of pronounced value, one which will be a new point of departure in rail study.

It has long seemed likely that progress in our knowledge of ordinary steel would be assisted in a most important manner by the study of high-carbon and special steels. Because of the larger number of variables which these steels contain, their sharply differentiated structure and their wide range of physical and structural modifications, they afford a vastly sharper picture of what goes on in the metal, though at the same time a more intricate and confusing one. The relatively dull aspect of the conditions existing in low-carbon steels, on the other hand, makes more difficult the discovery of physical peculiarities. If, then, the investigation of snowflakes has already reacted on rail study, it may also prove to have a bearing on some of the questions surrounding the structural steels. Should the parallelism of flake and transverse-fissure phenomena be established definitely, it would furnish a new demonstration of the essential unity of steel study.

Outlets Govern Land Reclamation by Drainage

LAND reclamation by drainage requires broader consideration from the viewpoint of finding adequate outlets through the larger elements in the natural drainage system, if it is not to be restricted to small local operations. This may mean extensive stream regulation, extending over two or more states and requiring interstate agreements if not Federal action. How extensive are the areas sometimes involved may be illustrated by Illinois and Indiana examples cited by Edgar A. Rossiter in a paper read before the recent drainage congress in Chicago.

In Illinois the Kaskaskia River passes through 25 counties and has 42 or more tributaries, with a combined drainage area of about 5800 square miles. Each of the 42 tributaries contains a catchment area sufficiently large for the organization of a drainage district, but under present laws no two catchment areas may join in one district, and without doing so full drainage development is impossible. Interstate or Federal action is necessary in the case of the Kankakee River, which drains 54 townships having a total area of 1,046,000 acres in Illinois and 74 townships with 1,695,000 acres in Indiana. Indiana cannot obtain relief until a large interstate drainage district is formed or the Federal Government acts in deepening the Kankakee River. When once the Kankakee River is deepened, the tributaries such as the Iroquois and Yellow Rivers, with creeks approximately 150 in number, will be able to drain this 3,000,000-acre watershed.

The examples described, Mr. Rossiter declares, are typical of every inland river in the Mississippi Valley and also of many of the rivers of the Eastern states. This being so, it is evident that both state and Federal action will be required if Secretary Lane's plan for reclaiming swamp and overflowed lands, now being studied in detail by engineers working under the United States Reclamation Service, is to be realized. Many of the state legislatures now in session should take these matters into immediate consideration, with a view to passing needed remedial measures before they adjourn.

Meeting Problems in Sewer Location

THAT not all the sewage need be pumped has been overlooked in laying out the sewerage systems of some of our seacoast towns. Where the grade is slight and a gravity flow is hard to get, owners of low-lying areas are wont to endeavor to force the decision to a low-level system of trunk sewers for the entire city, delivering to a pumping plant. The popular cry is for a system to serve all areas, making no "discrimination against sections which happen to be slightly lower than other portions of the city." Unfortunately, the political aspect of such situations often beclouds the real problem to the extent that a feasible middle course is not sought.

No such mistake was made in planning improvements recently effected in the system at Santa Barbara, Cal. Two sections of the city were so low that, if they were served by a gravity system, tidal waters would back up into the trunk lines so that discharge into the ocean would occur only during low tide. In fact, in the original system installed to serve the lowest portions of the city, this condition had existed for years, constituting a continual source of annoyance. In planning the recent extensions and improvements to the system, the usual suggestion of a common sump, with a pumping plant to handle the total sewage flow, located somewhere along the ocean front, was proposed to the engineers. They dismissed this, undertook to find a more economical solution, and succeeded. The new system has a comparatively high level outfall which discharges above high-water line and a small part of the sewage has to be pumped up to the main trunk sewer. The trunk lines of the old system serving the low water-front section of the city were not disturbed, but were tapped by a new line draining inland. This line leads to the other portion of the town, where a small area was below the level that could be served by an outfall above high water. At this second low area a small pumping plant was installed to lift the effluent from both low areas into the new gravity line. A system was thus laid out successfully with a pumping plant just one-tenth the size that would have been required to handle the total sewage of the city. The saving in the cost of operation alone, as compared with that of a pumping plant to handle the total sewage flow, would pay the interest on a $60,000 investment. The entire cost of the extensions and improvements was only about $30,000.

It is by such planning and saving as this that the engineer justifies his professional existence. If the lesson could be borne home to the city fathers of many a community, much good money would be saved.

Operating a Hydraulic Dredge Under Difficulties

After Old Spoil Banks To Drainage Canal Had Slipped, This Type of Excavator Was Only One Available To Dig Out Log-Filled Earth in Channel

By Albert S. Fry
Morgan Engineering Co., Memphis, Tenn.

HYDRAULIC dredges are not as a rule used to excavate stiff clay material which is filled with stumps, logs and vegetable débris, but a combination of circumstances made this type of digger the best available for some reconstruction work on a cutoff channel of the Bogue Phalia Drainage District in Washington County, Mississippi, where old spoil banks had slipped into the channel. The dredge was nearby and could be had, and, besides, it was the only type of equipment which would insure getting the excavated material far enough back of the banks to prevent a recurrence of the slips.

The channel was originally constructed by a dipper dredge in 1914 and 1915, with a bottom width of 70 ft., an average width of 15 ft. and side slopes of 1 to 1. The excavated material was deposited in spoil banks on either side of the channel, leaving a berm 15 ft. wide between the top of the excavated slope and the channel side toe of the spoil bank. The material, as it was deposited, formed a bank from 12 to 18 ft. high and from 60 to 90 ft. wide on the bottom.

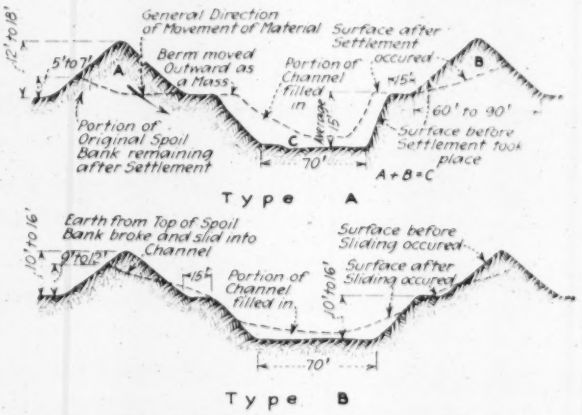
The channel lies for several miles in the bed of an ancient lake, now dry. This lake bed was a cypress brake when the channel was dug through it. At the eastern end of this ancient lake bed the channel empties into an existing lake, through which for about a mile no excavation was necessary. Going out of the lake, a channel was excavated for about a mile and a half to an outlet in another lake, which in turn emptied into a river.

Within about six months after the original excavation, earth movements occurred in the spoil banks that resulted in filling in the channel for a distance of about a mile below the lake and for about the same distance above. These movements were of two distinct kinds.

The Two Kinds of Movement

The first kind, which began about a quarter of a mile above the lake and extended for about three-quarters of a mile further upstream, is designated as type A in the accompanying diagram showing the character of the movement. The greater part of both spoil banks settled down, resulting in a crowding in of the sides and a pushing up of the bottom. The great weight of the spoil bank pressing downward on the original earth under the spoil bank resulted in this earth below the original surface giving way along some plane of rupture and forcing the material into the channel. At the place of greatest movement scarcely 50% of the original area of the channel prism remained. Along some portions of the channel the restriction was greater than at others. One noteworthy and remarkable feature of this movement was the fact that the entire berm moved bodily outward along both sides of the channel, the outer margin of the berms lining up as evenly after the movement as before. The earth comprising the berm at the surface, and for some depth, must have moved outward as a mass. Stumps in the earth on the berm were absolutely undisturbed by the movement.

Another peculiarity about the settling of these spoil banks was that it occurred only along the banks of

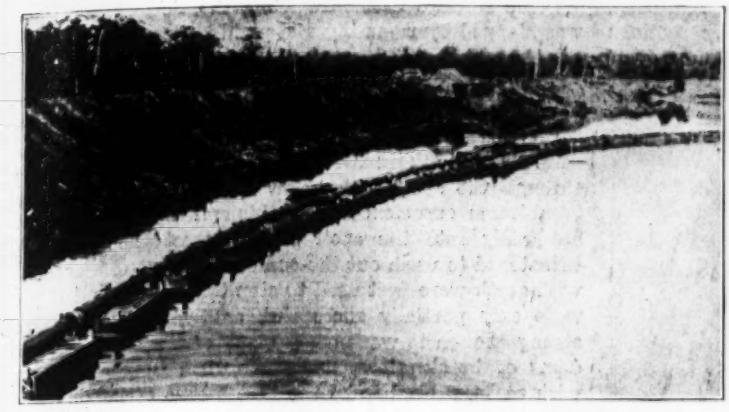


TWO TYPES OF BANK SLIP ON DRAINAGE CANAL

three-quarters of a mile of the channel, whereas along some four and a quarter miles where the excavation and spoil banks were of the same or even somewhat greater size no movement took place. Borings taken preceding the excavation, and an examination of the spoil banks after excavation, disclose no difference in the character of the material excavated. The weight of the spoil banks could have been no greater than elsewhere. As a matter of fact, some of the banks which settled were smaller than some which did not, and hence must not have had as great weight. For unknown reasons, less cohesion between the soil particles must have existed along the banks which settled than along those which did not.

The second type of spoil-bank movement occurred in the mile below, and for a quarter of a mile above, the lake, and is shown as type B in the diagram. In this case the high, steep spoil bank ruptured and slid into the channel and onto the berm, carrying with it into the channel a part of the berm. Where large spoil banks are deposited by dipper dredges, such earth slides are not uncommon, especially if the excavation is through earth upon which has been growing cypress or tupelo gum. In this case, the channel had been dug through a cypress swamp. Earth slides of this nature are ascribed to the excessive weight and steep side slopes of the spoil banks resulting from the concentration of the material due to the limited spoiling capacity of the machinery.

The cutoff channel had been designed to carry flood waters that would otherwise overflow and damage valuable agricultural lands. It was therefore a matter



WOODEN PONTOONS SPECIALLY BUILT TO CARRY SPOIL PIPE

CUTTER HEAD OFTEN CLOGGED

of immediate importance to redredge the channel so that it would have the capacity for fulfilling its intended purpose. It was found that about 116,000 cu.yd. of material would have to be taken out.

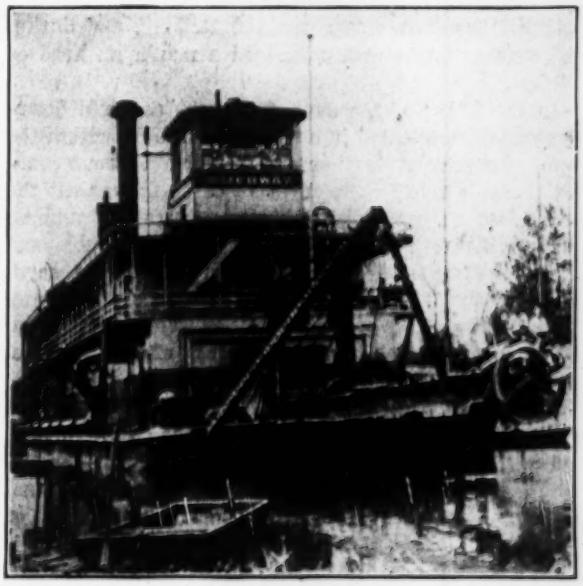
Selecting the equipment to do the work offered a considerable problem. The dipper dredge that had made the original excavation had been removed from the work. To install another dipper dredge, or a dragline or cableway excavator, of a size adapted to the work, would have been costly. Furthermore, these types of excavators were looked upon with disfavor in the present case because of their limited capacity for spoiling material, for it was not desired to trust any great concentrated weight of spoil bank on material that had already moved in the manner described.

The cutoff channel empties into the Sunflower River, a navigable Government stream, and it so happened that a United States Government hydraulic dredge, the "Waterway," was just finishing some Government work in the vicinity of the mouth of the filled-in channel. Negotiations were entered into which finally resulted in the renting of the dredge by the Drainage District to do the redredging. It was recognized from the outset that the excavation, which consisted of stiff clay or gumbo soil in which were many buried logs and stumps, was far from ideal for a hydraulic dredge, and that the costs of the work would be higher than for ordinary hydraulic dredging. However, the hydraulic dredge was immediately available, and by hydraulic dredging the excavated material could be spoiled over a wide area, so that all danger of recurrence of the earth slipping would be averted. These factors more than overbalanced the difficulties which it was anticipated would be encountered in doing the work by hydraulic dredging.

The "Waterway" is a stern-wheel steel-hull dredge, 163 ft. long and with a beam of 37 ft., a depth of 7 ft., and a draft between 3 and 4 ft. The centrifugal dredging pump is driven by a nonreversing triple-expansion engine, 10, 16, 26, by 12 in. The pump runner is 50 in. in diameter. Steam power for operating the dredge is furnished by two horizontal Mississippi River type boilers. The suction head is equipped with an eight-blade spiral cutter head 4 ft. 9¼ in. in diameter. Leading from the pumping engine, which is near the bow of the boat, are discharge pipes of 16-in. diameter which terminate, one on each side of the boat, some 10 ft. above the level of the lower deck. The discharge can be turned into either pipe as desired.

When the dredge operates in large streams or rivers, for which operation it was designed, a line of floating discharge pipe connects onto the discharge pipe from the pump, these floating pipes being supported by steel pontoons which float alongside and back of the boat. But the Bogue Phalia channel was not wide enough to allow the dredge to operate with the pontoons floating alongside the boat, so it was necessary to modify the discharge equipment before excavation could begin. By a special pipe arrangement, the starboard discharge pipe was joined with a line of pipe clamped at the outer edge of the starboard guard on the boiler deck of the dredge. At the stern of the boat a special "down-and-out" offset pipe connected the pipe on the deck with the floating line.

The steel pontoons and discharge pipe used by the "Waterway" in river work were also too large to permit of their use in the channel to be redredged, and



RIVER HYDRAULIC DREDGE DRAFTED FOR CHANNEL CLEARING WORK IN DRAINAGE CANAL

wooden pontoons, 13 ft. long by 7 ft. wide by 2 ft. deep, were built to carry a line of floating pipe in sections 16 ft. long. The floating pipe was connected by rubber sleeves 24 to 36 in. long. To connect with the floating

MATERIAL WAS MOSTLY DELIVERED IN LUMPS

line, shore pipe in 16-ft. sections with telescope joints was provided.

Another preliminary which had to be undertaken was the construction of a dam across the lower end of the channel, to maintain a sufficient stage of water for operation of the dredge. This dam consisted of two lines of rough Wakefield piling driven about 25 ft. apart, and supported by a system of round piles which were braced from one to another horizontally and diagonally. To tie the sheeting together, 1¼-in. steel tie-rods were used. Between the piling, an earth fill was placed by the dredge itself. A crown was eventually put on by wheelbarrows after the hydraulic fill had settled. The dam was about 100 ft. long, and during the course of the work withstood a maximum head of 14 feet.

In the filling of the dam, a blowout occurred downstream which resulted in a sinking of the fill within the dam. To prevent further trouble from blowouts, material was pumped in to form an earth fill against the lower leaf of the dam. This was successful and no further blowouts occurred, although some trouble was experienced at a later time from slipping of the earth fill below the dam, due to the water being drained away from the lower side of the dam. Some short sheetpiling driven near the toe of the fill proved effective in preventing further slipping.

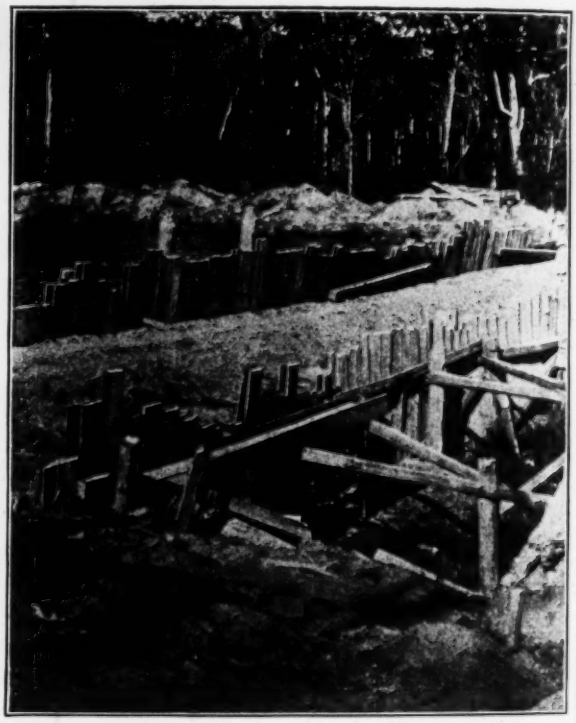
While the work was being carried on, the water pressure against the dam, combined with the settling of the material in the dam, caused the upstream sheeting to lean downstream. As a safety measure to guard against further movement, cables were attached to each end of the sheeting about 15 ft. from the ends of the dam, the cables leading upstream to trees along the bank. These cables were not called into play, however, as the sheeting did not move after they were in place.

Some seepage developed along the tie-rods, but this was stopped by ramming and puddling material around the rods.

Around one end of the dam, a spillway to carry away the flow in the main channel was blasted and dug through the existing spoil bank into an adjacent slough, returning to the main channel by a similar ditch through the spoil bank below the dam. Considerable trouble was experienced with this spillway, as the water cut badly into the spoil bank nearest the dam and threatened to wash out the end of the dam. Sacks filled with earth were first used to stop the cutting, but these were only partially successful, as the current proved strong enough to wash away many of the sacks. Wing dams or breakwaters, made of brush in combination with sacks, proved to be the best means of holding the spillway channel from cutting.

After the excavation work was completed, the temporary dam was removed, so that the dredge could return to the Sunflower River.

The excavation work was performed in two shifts of eight hours each, one working from 4 a.m. until noon,



TEMPORARY DAM BUILT TO MAINTAIN ENOUGH WATER TO FLOAT DREDGE

and the other from then until 8 p.m. Each shift consisted of an engineer, a leverman, an oiler, a water tender, a stoker, and from six to 10 deck hands. The captain of the boat superintended operations, being assisted by a mate. A pilot made up the remainder of the crew, excepting the cook, the laundress and the cabin boy. In addition to the dredge crew, a shore gang of from 10 to 12 men was required to blast and remove logs and débris ahead of the dredge. Considerable difficulty was experienced in keeping full crews, owing to the drafts of the Army and the general spirit of unrest

caused by the war. This condition no doubt had its effect on increasing somewhat the cost of the work.

The excavation required the removal of material from the bottom and sides of the channel. In the digging position, the boat was held steady by a central spud just in front of the stern wheel. By means of a cable passing over sheaves on the ladder frame and stretched across the channel ahead of the boat—this cable being anchored at each end to a dead man laid in trenches on the banks—the boat was swung across the ditch on an arc of which the spud was the center. Raising and lowering the cutter head ladder provided the vertical movement necessary. Ordinarily, the dredge could perform the excavation entirely across the ditch from one anchoring of the spud, but in some places, where excavation was heavy and work was carried close in to the bank, two set ups were necessary.

The material that had to be excavated presented a difficult task for a hydraulic dredge. The original excavation had been almost entirely through wooded country, and the logs and slashings on the right-of-way for the channel had been piled beneath the spoil banks. When the slides occurred, much of this débris, together with stumps, was carried along with the material that encroached on the original channel section. The material itself was a stiff clay or gumbo soil.

Preceding the dredge excavation, the shore gang blasted out and removed as many of the buried stumps and logs as was possible. This task was surrounded with difficulties. The logs and débris that had been under the original spoil banks formed a matted mass that was extremely hard to remove. It was impossible to blast all of the logs and stumps, and many remained which had either to be "nosed" out by the cutter head or chewed up by it.

Floating ahead of the boat was usually a thick mass of chunks, made up for the most part of heavy pieces of stump or logs mixed in the material. These chewed-up pieces of logs and stumps, together with chunks and roots, gave endless trouble from plugging up the pipe line, and delayed the work considerably. The trouble from floating chunks was finally mitigated to a large extent by clearing these out of the way by means of a floating boom. The boom consisted of short pieces of logs held together by a cable. With a boom of this kind, the chunks could be worked to the rear of the dredge and then held against the bank by the fastening of the ends of the cable to the bank.

During part of the digging a great many cypress stumps, knees and roots were encountered, and no difficult excavation can be imagined for a dredge of the "Waterway" type than cypress stumps, knees and roots.

The material itself also gave trouble, the nature of which can be seen from the view of the clogged cutter head. The stiff character of the digging resulted in the clogging of the cutter head so that it had to be cleaned at intervals by the deck hands with bars and shovels. Removing this material from the cutter head usually required from 20 min. to an hour. By reversing the cutter-head engine at full speed, the material could be shaken loose in about 4 min., but this method was very hard on the machinery and had to be abandoned for that reason.

The excavated material was pumped through the floating line of discharge pipe to the line of shore pipe. In order to discharge the material behind the existing spoil banks, trenches in which to lay the pipe had to be dug and blasted by the shore gang in advance of the dredge. These trenches were made along one side of the channel only as all of the material was spoiled along one side.

When excavation was started after the shore pipe was laid in a new trench, the floating line was formed in a half circle from the stern of the boat to the shore

ILLUSTRATING THE KIND OF MATERIAL THAT HAD TO BE REMOVED

connection. As the dredge moved ahead, the floating line straightened out until it formed nearly a straight line from the stern to the shore-pipe connection. Either more pontoons of floating pipe would then have to be inserted in the line, or the shore line would be moved forward. Usually, a movement of 200 to 300 ft. forward was made before shifting the shore line.

The head pumped against varied from 8 to 15 ft. When the floating line was short, this head did not cause any trouble, but when the floating line stretched out to 300 or 400 ft., only frequent flushing and alertness to forestall buckling at the rubber sleeve joints would prevent a plugged discharge pipe.

Apparently, but little of the dredged material was discharged in solution. The spoil consisted principally of balls of mud ranging in weight from a few ounces to several pounds. This material assumed a slope of about 15 or 20 to 1, and where the original spoil bank was low, and the redredging heavy as a consequence, the material formed a continuous well drained deposit wherever the lines of shore pipe were not spaced more than 200 ft. apart.

Repairing the main spud, which was broken twice,

constituted the chief item of repairs that were made during the work.

After it broke the first time, a 70-ft. gin pole was rigged on the bank of the channel to replace the spud, the timbers for the gin pole being cut out of the nearby woods. The spud itself is about 40 ft. long. A green elm stick cut out of the woods was used for replacing the first spud. After a couple of weeks' service this broke. The gin pole had not been taken down after the first new spud had been put in, so the second was put in without much difficulty. For this spud a seasoned gum timber was used. This proved serviceable, and no further trouble was experienced with the spud.

At the close of the job it was necessary to replace some of the principal parts of the cutter-head engine which had worn out during the work, due to the hard service performed by the engine.

Progress and Cost

Records were kept during the entire period of operation of the dredge. The dredge was on the work a total of 141 days, of which 120 were working days, Sundays and holidays being excluded. Of the working days, 12 were occupied in modifying the discharge equipment, filling in the dam and making repairs, leaving a total of 108 days when dredging was done. A total of 116,400 cu.yd. was excavated at an average rate of 1080 cu.yd. per day of 16 working hours.

Delays consumed 30% of the total available dredging time. These delays were of three general classes. Necessary operations of the boat, such as moving the boat, moving, extending or repairing the discharge line, and adjusting machinery, comprised 13% of the total time consumed.

The character of the material excavated caused delays for removing snags, chunks, roots or other débris which lodged in the cutter head, the suction line or the discharge line, and which took up 10% of the total time. Major repairs delayed the work 7% of the time.

It had not been expected that the cost of the work would compare favorably with usual hydraulic dredging costs, owing to the difficult conditions under which the work was done. The cost of the work, excluding supervision, engineering and overhead charges, was 41.7 c. per cubic yard. This was made up of the following items:

A	Preparatory and Incidental Work		
	1. Additional equipment and preliminary work	$0.054	
	2. Dam and spillway	.038	
	3. Clearing and grubbing	.031	
	4. Passage through bridge	.004	
	5. Transferring boat to river after work was completed	.020	$0.147
B	Dredge Operation		
	1. Rent	$0.084	
	2. Labor	.070	
	3. Subsistence	.037	
	4. Coal	.056	
	5. Supplies	.009	
	6. Repairs	.010	
	7. Incidentals	.004	.270
			$0.417

In connection with these costs, it must be borne in mind that the work was done during the summer of 1917, and that materials and labor had not reached the high figures which they did several months later.

The entire work was carried out under the supervision of the Morgan Engineering Co., of Memphis, the direction and planning of the work being done by [illegible] H. Sayford. T. P. Anderson was resident engineer [illegible] Capt. R. N. Ferguson, of the dredge "Waterway," superintended the dredging operations.

Civil War Price Trends Compared With Those Today

Judging By Past, Prospect Is That High Prices Will Continue—Should Not Retard Immediate Building

By Morris Knowles

President, Morris Knowles, Inc., Engineers, Pittsburgh, Penn.

PRICE movements in the next few months and years will have a serious effect on all construction activities; more than that, the expectation of lowering prices is one of the leading causes of the present lack of construction. As a result of a study of numerous factors that go to make up prices, and particularly of the periods following previous American wars, especially the Civil War, it seems to the writer that the trend of prices probably will not be downward as rapidly as some hopeful minds indicate.

The question of whether prices will fall soon, how far they will go down, and how rapid that decline will be, are problems which cannot be accurately solved. And any assumption which can possibly be made as to the probable trend of prices during the next few years may be shown in the future, when one can gaze with a perfect hindsight upon the past, to have been nothing short of a wild guess. However, it has been the practice of engineers and those accustomed to plan for the future not to be fearful of later condemnation in making estimates. It has been the practice of the engineering profession to gather all data which affect the particular problem at hand, to study the effect of such conditions in the past, and to apply the expected results of similar conditions to the future. Then the future can be projected and predicted, with the imperfect vision which all men must have of the events of tomorrow.

No Index Numbers for Construction Material

One of the best means of measuring the trend of prices is that of "index numbers," which are the sums or averages of the prices of a number of commodities referred to a given year as a base, usually noted as 100. However, no standard index numbers exist for engineering construction. There is shown in Fig. 1 a diagram comparing Dun's index numbers of 200 commodities, with a curve of index numbers made up from a study of about 25 construction materials. The diagram shows that while the relation between the general index numbers and an engineering index number for construction work is not exactly the same, for all years they would probably vary in their trend quite closely, and, therefore, general index numbers may be used in a general way for this purpose of studying the trend of construction prices. Fig. 2 shows curves of index numbers for the periods before, during and after the Napoleonic and the Civil Wars, and also from 1884 to date. These are arranged so that the peak in each case coincides with 1918, which is considered the peak of the present war. It will be noted from this diagram that it was

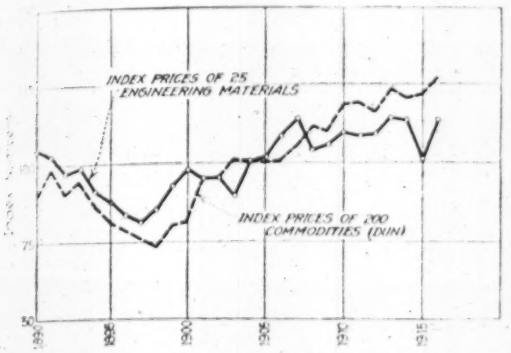


FIG. 1. PRICES OF GENERAL COMMODITIES SHOW ABOUT SAME TREND AS INDEX COSTS OF BUILDING MATERIALS

generally many years after the wars before the prices recovered completely from their increase. After a study of the trend of prices following previous wars and considering the conditions which have obtained at those times, it is believed that the curve which can be applied to American conditions as seen today is that of our Civil War in 1860-65. Even in this case, comparisons must be made with extreme care, and subject to many modifications. After the Civil War it was not until 1878 that the price level was as low as it was in 1860, or a period 13 years after peace was declared.

In order that we may intelligently apply the experience of 1865 to that of 1918 and the years following each, it is necessary to consider the economic conditions which existed at that time as compared to those of the present; and a word concerning each may be advisable, without attempting to discuss intimately all the data used in reaching conclusions.

It may appear, first, that the change in prices following 1913 was considerably greater than the corresponding change following 1860. However, this is more apparent than real. The difference is lessened when it is considered that the Civil War occurred during a period of falling prices and the present war occurred during a period of rising prices, so that the angle of the change of direction of the two curves is probably about equal.

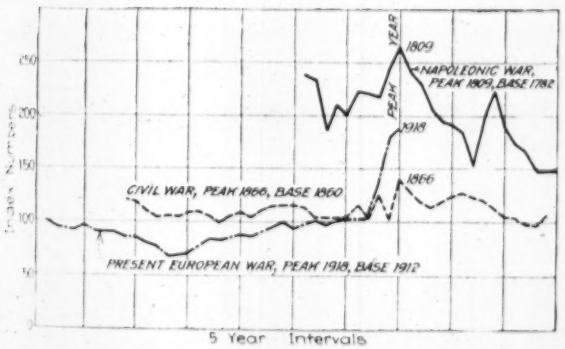


FIG. 2. COMPARISON OF INDEX PRICES FOR PERIODS DURING AND FOLLOWING RECENT WARS

Data as follows: Napoleonic War—Jevons. Civil War—United States Bureau of Labor. Present War—United States Bureau of Labor.

One of the important factors in the trend of prices is the labor market, and although statistics are not very accurate as to the amount of labor that has been withdrawn from ordinary pursuits during the war, yet from those data which are obtainable, as compared with the figures during the Civil War, it is indicated that probably a greater percentage of labor was withdrawn for actual military service during the Civil War than during this war. But the interference with the supply of labor today is far greater than it was during the Civil War. While the men withdrawn for military service constitute a smaller proportion of the population than they did for armies of the Civil War, "the men behind the men behind the guns" are many times as numerous, and there may be much difficulty in readjusting these men to a peace basis, if lower wages are to be offered. Interference with immigration has been far greater during the present war and is likely to continue longer after its close. Sufficient data on the participation of women in industry are not available for comparison of the two periods.

The diversion of capital to distinctively war industries has been on a vastly greater scale in the present war, and the process of restoring it to peace industries at the end of the war will be proportionately slower and more costly than in 1865. The absence of free land, on which to set to work the returning soldiers and the laborers released from war industries, will greatly increase the difficulties due to readjustment.

The nature of the foreign trade of this country at the outbreak of the European war has brought to it an amount of gold far in excess of its normal share of the world's supply. On the basis of this gold, the amount of paper money in circulation also has increased. It is this increase in money, reinforced by similar increase in credits in bank loans, which has been one of the most influential factors in the present price situation.

Owing to abnormal conditions prevailing in the countries in which the larger part of the trade with the United States has been carried on in the past, there is but slight prospect that normal conditions of money and credit will be restored, or that the trade balance will be reversed by sending gold abroad to pay for goods. It is probable that the present trade balance will prevail for some time.

As modern industrial society has abandoned the individualism of the middle of the past century, the new practice of coöperation of producers and regulation by governmental authorities will tend to stabilize prices and retard their movements in either direction, upward during the war, and, it is expected, downward after the war. Price-fixing has been recognized for a long time among public utilities, and the recent experience during the war may lead to continued governmental action along the same lines as regards food and other essential products.

The import tariff will also be used, as it has been used in the past, to protect the high prices existing in America, and as labor is organized and will relinquish its present high rates very slowly, it is probable that this factor, together with the tariff, will be used for a long time to help maintain the present high price level. Any expectation that a fall in prices, even due to panic conditions (unless unusually severe) will result in a return to anything like those which obtained prior to the war, will evidently result in false hopes. Witness the panic

of 1871-1873; while producing a small lowering in prices, it did not bring them to anything like the level which obtained in 1861 or again in 1878 to 1880.

In view of these conditions—namely, upward trend of prices previous to the war, difficult labor conditions, immobility of capital, foreign trade balance, price-fixing and the protective tariffs—it is believed that the period of high prices will continue for a longer time after the period of the present war than it did after the Civil War. If panics and the like are to be averted, with other unrestful and undesirable economic conditions, public works should be started, rather than that we should sit tight and wait for prices to come down, in the hope that this reduction in prices will be very soon. It is doubtful if such reduction will occur within the near future to any marked degree, unless factors other than the economic conditions now prevailing come into play.

The Construction Division of Our Army

A Description and Interpretation for Engineers and Laymen of a Great Organization and the Works It Built—On Nov. 11, 1918, Some 1480 Civilian Engineers Were Putting Through a $1,200,000,000 Program

By George W. Fuller
Consulting Engineer, New York City

UNFORTUNATELY, most members of the engineering profession fail to record adequately their work so that it may take its proper place in the mind of the layman. This could not be more strikingly evidenced than by the fact that there is just being completed an engineering work probably unequalled in the history of the world, but which, as regards the organization doing it, has left so little mark on the mind of the average person that its very existence is almost unknown. When the armistice was signed in November, 1918, 1480 constructors—engineers in the broadest use of the term, and not in its military sense—were wearing the uniform of the United States Army and under the name of the Construction Division were carrying through a building program involving $1,200,000,000, marvelous in its extent and doubly wonderful in the speed and comparative economy of its execution.

The Panama Canal took 10 years to build and cost about $375,000,000. The work of the Construction Division of the Army in one of the early months alone amounted to almost twice the volume of work done in any year at Panama, not only in money expended, but in materials handled, and this, too, at a time when men and materials were most difficult to procure and when transportation facilities were frequently paralyzed.

Many persons who have knowledge of the performance of any part of this building program, seem to be, through the confusion of the work of the military engineer and that of the Construction Division, under the general impression that this work was done by the Corps of Engineers of the United States Army. It should be clearly set out that the Corps of Engineers during the world war was charged almost exclusively with construction work in France while, on the other hand, all of the construction work for the Army in this country has been and is under the direction of the Construction Division of the Army, which was also responsible for the design and operation of all cold-storage and refrigeration plants in France.

Civilian Engineering

To appreciate better the immense value of the civilian engineer in this building program, a clear distinction should be made between the duties of the military engineer and those of the Construction Division. The training and practical experience of the military engineer have been along the lines of pre-war fortifications—trench digging, field bridging, mining, sapping, military railways, and other activities generally classed as combatant work. The Construction Division of the Army is that bureau of the War Department which is charged with the entire construction work of and for the Army in the United States, including the Hawaiian Islands, the Philippines, Alaska, Porto Rico, and the Canal Zone. This includes not only the design of the projects, but the procurement of the necessary materials and labor and the supervision of the work itself as regards construction, operation and maintenance. This work calls for men of wide experience in commercial building projects, men who are familiar with the most up-to-date methods of modern planning and building construction in all its phases, including the operation and management of public works and utilities.

Only Three Regular Officers in Division

The Construction Division is a combination of the civilian engineer, the architect, the town planner and the builder, dealing almost entirely with problems similar to those met in the usual lines of construction work carried on during times of peace. An interesting fact bearing on this is that throughout its existence the Construction Division has not had connected with it more than three officers of the regular Army out of a total commissioned personnel of 1485.

The work of the Construction Division of the Army commenced in May, 1917, under the name of the Cantonment Division of the Quartermaster General's Office. The problem at that time was the building of 32 camps and cantonments for the new National Army and Federalized National Guard. Upon the completion of this work in the fall of 1917, the Secretary of War decided that it would be for the best interests of the Government to consolidate all construction work of the Army in this country under one responsible head, that of the Cantonment Division.

The construction projects were necessarily scattered throughout the whole United States, involving problems of transportation not only of materials but also of the necessary workmen.

At one time 200,000 men were employed in the field alone. The work, exclusive of maintenance and repairs, included about 530 operations at 450 different and

widely separated locations. On many projects transportation and living facilities were utterly lacking and required the building of roads and railroads and the providing of living accommodations for the workmen before actual construction could start. In other cases not only was this true, but it was necessary first to clear sites for the work in what were practically forests.

The housing accommodations comprised about 40 large camps and several hundred minor projects, providing accommodations for about 2,250,000 men. In connection with the large camps and the smaller projects as well, in addition to the housing, there were provided the necessary supplementary buildings and utilities. In the case of the major camps practically a complete city was built, including roads, walks, electric lights, water-supply, sewers, sleeping quarters, mess halls, lavatories, theaters, post-offices, store buildings, telephone and telegraph offices, power houses, laundries, storage buildings, hospitals, stables, garages and ice plants.

Army bases, interior posts, expeditionary depots, warehouses, terminal piers, wharves and docks have been constructed along most modern lines and on an hitherto unequaled scale. The areas total 27,502,300 sq.ft. of warehouses and pier sheds and 2,176,000 sq.ft. of open sheds, giving a grand total of substantially 30,000,000 sq.ft., or 690 acres, of storage space. The magnitude of this total can best be conceived by considering that it equals a building 70 ft. wide and 80 miles long or about equal in length to the distance from New York to Philadelphia. Most of the warehouses are of reinforced concrete. These figures do not include miscellaneous warehouses or magazines, or those at camps, or used exclusively by the Ordnance Department. Adjacent to the terminal piers and docks there are completed or well advanced 39,000 lin.ft. of wharves, equivalent to 7.4 miles, for loading ships. This wharfage provides generally for channels with a depth of 35 ft. at low tide and is sufficient to berth 65 ships at one time on the basis of 600 ft. in length of wharf per ship.

There have been built about 844 miles of railroads, exclusive of local trestles, etc., and about 1061 miles of roads, of which a large percentage are of concrete.

The hospital section has built or reconstructed buildings to accommodate 121,000 patients' beds, and in addition has provided quarters for about 12,000 nurses, 24,000 enlisted personnel and 4000 doctors. As in the case of camps, on many hospital projects it was necessary to install all utilities, such as sewers, water, gas, electricity, roads and railroads. To picture the extent of hospital construction, it may be said that if all these Army hospital capacities were consolidated there would result a population about equal to that of Worcester, Spokane or Memphis.

Work for Ordnance Department

For the Ordnance Department alone, there have been built more than 7,933,000 sq.ft., or 181 acres, of industrial and storage buildings, about 7000 lin.ft. of docks and about 3,250,000 sq.ft. of magazines. The work for the Ordnance Department and the Chemical Warfare Service has aggregated a cost of about $150,000,000, of which the following is a brief description:

Six artillery proving grounds, of which the largest, at Aberdeen, Md., contains about 38,000 acres and has cost about $15,000,000. These proving grounds are used to test all guns, from trench mortars to railway mounts and the 16-in. coast-defense guns, as well as for testing ammunition of all kinds, including the various types of gas shell. They are provided with steel and brick machine shops equipped with electrically driven machinery, including overhead cranes, etc., for assembling and repairing artillery.

Seven ammunition storage depots, of which the largest, at Raritan, N. J., contains over 90 fire-resisting magazines, has a storage capacity sufficient for nearly $400,000,000 worth of explosives and cost about $12,000,000. Most of these depots are provided with extensive dock facilities and from 20 to 30 miles of railroad sidetracks.

Various fire-resisting buildings of steel, brick, reinforced concrete and hollow tile, together with miscellaneous machinery, were provided at nine of the permanent Government arsenals, which are scattered from New England and the Atlantic coast to California and Texas. There is no uniformity in the requirements of this permanent arsenal construction but in several cases it has run into considerable money. At Watervliet, for example, it included a steel and concrete machine shop about 250 x 600 ft. in plan and other buildings of like character, which added about 4000 employees to the manufacturing force at that point.

Nine Ammunition Assembling Plants

Nine plants were built for assembling ammunition, etc., including shell-loading plants for fixed ammunition, bag-filling plants for loose ammunition, two cartridge factories, one plant for loading aërial bombs and one for manufacturing incendiary bullets. Several of these installations cover three or four square miles, with 300 to 500 separate buildings in one plant and 30 to 40 miles of sidetracks, besides power station, machinery and equipment of all kinds. Much of this machinery, and to a large extent the operating buildings themselves, have had to be designed especially for their purpose.

Twenty chemical manufacturing plants, with their buildings, facilities and equipment, for the manufacture of T.N.T., picric acid, tetryl, toluol, sulphuric acid, phosphorus, mustard gas, tear gas, sodium cyanide and liquid nitrogen, were built. These plants cost from $1,000,000 to $13,000,000 each, and in most cases included housing facilities for the operating forces, as the plants were necessarily isolated.

The Edgewood arsenal, at Edgewood, Md., includes a plant for producing chlorine and other gases, many times larger than any other in the world, an extensive gas-shell filling plant, fire-resisting barracks, two hospitals, a 600-ft. dam and reservoirs, and a 20,000-kw. power station, costing in all about $25,000,000.

Various factories or factory additions were built for the manufacture of Liberty motors, tank tractors, automatic pistols, etc., and various laboratories and experimental stations.

The work of the Construction Division, summed up briefly, has covered such diversified projects as camps, cantonments, wharves, docks, forts, arsenals, great port

terminals, reserve storage warehouses, hospitals of all sizes and description, aviation fields, proving grounds, embarkation camps, engineer camps, gunnery schools, housing, lighters, power plants, factories, additions to manufacturing plants, munition plants, and special new plants, for the production of nitrates, phosphorus, T.N.T. and miscellaneous acids, gases and explosives.

Relations with Other Branches of Service

By the autumn of 1917 the necessity for munition plants, for aviation fields and training schools, quartermaster storage depots and terminals, for powder plants and magazines, for factories, as well as special camps and training schools, was most urgent throughout the country. Every bureau of the Army had developed or was attempting to develop an organization for the construction work required by the program of its own particular activities. This resulted in competition between the various bureaus, not only in the markets for labor and materials, but also in the field of experienced builders, engineers and other similar technical men. There arose in these bureaus constructing organizations and engineering departments whose work it was naturally impossible to coördinate, and there resulted the inevitable loss in efficiency.

The combining of the building activities of the War Department thus became necessary, quite naturally, and, each bureau having its own organization, there also arose the need for a decision as to which bureau should be charged with the construction program on this side of the Atlantic.

The Cantonment Division at this time included officers principally from the Quartermaster Corps, as well as others from the Ordnance Department, the Corps of Engineers and the Signal Corps. This condition was due to the fact that very early in the war the entire commissioned personnel allotted to the Quartermaster Corps was exhausted, and those in charge of building up the Cantonment Division requested that the men selected by them from civil life should receive commissions in other corps, where commissions were available, and then that these men be transferred to the Construction Division. Although an understanding of the procedure makes it clear that such men of the Signal Corps, for instance, as well as those of the other corps, were not trained in the special work of the bureaus in which they were commissioned, but were essentially Cantonment Division men, nevertheless, various bureaus have been inclined to feel that they were perhaps partly responsible for the remarkable achievement of the Cantonment Division. And there has been a desire on the part of other corps to be charged with the responsibility for this construction work.

Between the Construction Division and the several bureaus of the Army for which work was being done there existed a most friendly and helpful spirit. All were concerned principally in expediting the work, and each lent to the other every assistance which would be of value in winning the war. In the case of the Signal Corps there were certain specialized types of construction wherein the men of the Signal Corps could probably benefit by experience in these specialized activities —as, for example, in the construction of balloon and airplane sheds—and these special building activities were not at that time taken over by the Construction Division.

The Construction Division sprang from the Construction and Repair Branch of the Quartermaster General's Office which, when this country became a participant in the world war, was composed of three regular Army officers with a force of 20 clerks and stenographers and about as many engineers, architects and draftsmen. The cantonments were built without making substantial demands on the Engineer Corps for reserve officers, as they were built essentially by civilians, many temporarily in uniform and most of them coming from 41 previously established engineering organizations and 61 contracting organizations. The design of the original cantonments, as regards general plan, was carried on in the Washington office where, up to July 1, 1917, there was only one Engineer Reserve officer. Among the original constructing quartermasters for the 16 cantonments, there was no Engineer Reserve officer, while at the 16 National Guard camps eight of the constructing quartermasters were Engineer Reserve officers.

The Construction Division has reported direct to the Chief of Staff since February, 1918, and it is essentially a part of the Office of the Chief of Staff; in that respect it is substantially on the same footing as any other department or corps of the service. The Army appropriation bill provides funds for the Construction Division through the Quartermaster General's Office, although the latter has no jurisdiction over these funds. It seems unfortunate that in the rush of its crowded program of work the Construction Division did not take the necessary steps to adopt a distinguishing insignia and thus establish in the mind of the public the individuality to which it is so abundantly entitled.

Growth and Development

The organization of the Construction Division, formerly the Cantonment Division, has been a matter of general growth and development, as its duties have broadened. From the four original branches of construction, engineering, materials and accounting, the division has been divided into seven branches as follows: (1) Building division, which supervises the construction of projects and keeps in touch and directs the constructing forces in the field from the Washington office and through its various supervisors; (2) engineering division, which is charged with the responsibility of the preparation of plans and estimates, and establishes and lays down the fundamental engineering principles, standards and requirements for the work; (3) contracts division, which deals with the preparation and execution of contracts and other legal matters connected with the work; (4) procurement division, charged with the mobilization and procurement of materials and the inspection of these, where necessary, at the source; (5) administrative division, charged with the keeping of necessary records, both in regard to labor and personnel, clerical routine, files and similar work; (6) accounting division, in charge of the accounts and expenditures on the projects, the examination of the field records and accounts; (7) maintenance and repair division, or, more popularly, the operation and maintenance division, which has charge of all main-

tenance as well as the operation of utilities of military posts and camps, and also the operation of similar units at all the projects handled through the Construction Division.

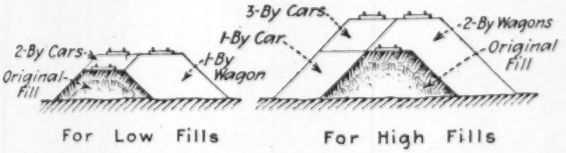
The building and the maintenance and repair divisions control the field work; an understanding of the activities of these divisions will, therefore, involve a complete understanding of the whole construction machine. Further comment will be made later on these two subdivisions, more particularly the maintenance and repair division, with the organization and work of which the writer has been familiar during the past year.

Dump Cars and Wagons Enlarge Railway Fills

Lack of Timber Excludes Use of Trestles for Filling —Work Trains Operate on Main Line— Sinkholes Cause Trouble

IN WIDENING and raising fills for double-tracking and grade reduction on the Cleveland-Indianapolis division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., in 1918, practically all the material was borrowed, there being few cuts because this part of the line traverses an elevated plateau. The borrow pits were mainly shallow and wide, because the general ground level is flat and the drainage is poor. Yellow clay, the principal material in these pits, was hard to excavate, but would slack after exposure. Beneath this was a stiff blue clay affording good foundation for structures. Shrinkage allowance in the fills was about 5% with scraper and dump-wagon work, and usually 10% for the large fills made by dump cars, although in the latter case it was sometimes increased to 20% for soft material.

Earthwork was handled in various ways, depending upon the quantity at each location. Light fills were made mainly by slip scrapers and leveled with road graders handled by teams. Some large fills were made by slip



TWO METHODS OF RAISING AND WIDENING FILLS

and wheeled scrapers, because the subcontractors had this type of equipment. Elevating graders and dump wagons were employed also on large fills, one contractor using teams, and another using steam traction engines, to haul the graders. Most of the heavy work, however, was done with steam shovels served by 12-yd. dump cars in 10-car trains which were operated on the main line by the contractor's 47-ton engines. These cars were dumped by hand, the material being leveled by a large spreader car propelled by a 60-ton locomotive furnished by the railway, as the contractor's engines were too light for this service.

In raising the grade on the old alignment by means of dump wagons, if the fill was comparatively low a side fill was first made alongside the existing work up to the limits of the final section, as shown by the drawing. When this had settled the new construction track was placed upon it, and the fill was widened and brought to grade by dumping from cars on this track.

With high fills, however, the old fill was first widened by dump wagons. With the running track detoured, the second step was to widen the old fill on the opposite side and bring it up to the new grade, by dump wagons. The third step was to widen the new fill by dump cars, bringing the first part of this fill up to final grade. Dumping from temporary trestles was the method planned originally for making the heavy fills, but as the necessary timber could not be obtained the methods described had to be adopted.

When time had been allowed for the fills to settle, the roadbed was graded and finished, and the track was laid on this subgrade, the rails and ties being distributed from the running track. Gravel trains with center-dump cars ran over the new track and deposited the ballast, the track being then raised by jacks and the ballast shoveled under the ties. A second layer of gravel was deposited in the same way and leveled by a plow on the rear car, after which the track was dressed to final surface and line. All the work trains operated entirely under flag protection and not on train orders, being required to keep clear of regular trains.

Trouble With Sink Holes

Three sink-holes caused trouble with the side-dump fills east of Union City. Soundings taken by the valuation engineers of the Interstate Commerce Commission in 1917 showed layers of cinders and gravel ballast extending to a depth of 38 ft., but no soundings have found the bottom of the wet, black, peaty muck of the sinkholes. As the filling was deposited along the old bank the black soil would rise in a ridge beyond it, sometimes to a height of 10 or 15 ft. above the normal level of the ground. Further movement developed also at a distance of 200 to 300 ft. from the fill. The settlement did not appear to affect the old bank, except that the latter was sometimes shifted out of line, and new material had to be placed on the rear side to hold it in position. The new fill, however, would drop 5 or 10 ft. over night, slipping down the slope of the old bank. Raising the dump-car track on a rough clay fill, after such a drop, was slow and tedious. It was expected that from 20,000 to 50,000 cu.yd. in excess of the original estimate would be required in each case, or about 100% increase in quantity. These sinkholes delayed the work somewhat, as the running track could not be shifted to the new fill, but it was planned to discontinue dumping clay and use cinders, until a stable fill was secured.

The concrete materials were distributed by the railway, which hauled sand, stone and gravel in its own 20-yd. air-operated side-dump steel cars, thus avoiding the use of gondolas or other regular freight cars and also permitting rapid dumping and clearing of main track without interference with train movements. The structures were mainly concrete boxes and culverts of cast-iron and concrete pipe, with a few short girder spans. The old National Turnpike crosses at one of the sinkholes, and will be carried by a reinforced-concrete undercrossing or subway 24 x 14 ft. formed as a massive monolithic structure. Pile foundations will

be provided, using 40-ft. piles and following these with others if they do not reach solid ground.

The Walsh Construction Co., Davenport, Iowa, had the general contract and did all steam-shovel and dump-car work with its own forces, under E. K. Hayes and W. I. Shillito as superintendents. Subcontracts were let for scraper and dump-wagon work, and all concrete work was sublet to the Cleary-White Construction Co., Chicago. Both native and foreign laborers were employed by the Walsh Co., with separate accommodations at the camps, as the foreigners prefer to do their own cooking. These men were mainly Bulgarians, Austrians, Greeks and Macedonians, but they worked together without much trouble. The pay for common labor was $4 per eight-hour day.

The work was under the direction of C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry. W. C. Kegler was district engineer, with F. N. Johnson as resident engineer on the section from Marion to Bellefontaine, and T. E. Earle as resident engineer from Ansonia to Winchester.

Successful Operation of the State Water Code of Oregon

Shows a Saving in Time and Water to Irrigator—Function of State Water Board, State Engineer and Water Master

By Percy A. Cupper
State Engineer, Salem, Ore

SINCE a number of Western states propose to enact or amend water codes during the present legislative session, a review of the Oregon code and operations under it may be of value, especially as it is generally conceded that this is the most successful code now in force.

Viewed from ten years of successful operation of the Oregon water code, it is difficult to understand why its enactment was so long delayed. In fact, it now seems strange that when provision was originally made for a definite record of land titles, no such provision was made for a definite record of water-right titles. When our constitutions were framed and early laws enacted, the fact that water for irrigation was worth more than the land itself was not generally recognized.

The result of our inadequate water-right records, or their total lack, is clearly seen in the way the courts have been compelled to decree imaginary water rights, or rather imaginary water. The courts cannot be held responsible for the lavish manner in which they bestowed water upon one of two litigants in a proceeding notwithstanding the fact that a large part of the available supply was covered by prior appropriations. Definite information as to the available supply and the amount covered by prior appropriations or the amount necessary for the needs of the litigants has in most cases been conspicuous by its absence. It is no wonder, then, that years of litigation between various water users on a stream has resulted in hopeless confusion of rights, while each new appropriation adds to the confusion.

The Oregon Water Code performs three distinct functions: (1) The determination of all existing rights; (2) the definite record of new appropriations, and (3) the distribution of water to the water users in accordance with their respective rights.

In Oregon the determination of water rights is made by the State Water Board, consisting of the State Engineer and the superintendents of the two water divisions into which the state is divided. The State Engineer is required under the statute to secure certain physical data relative to the amount of water available in the stream under adjudication, the amount actually applied to the lands or other use, and the capacity of the various ditches. In addition, he is required to prepare a map showing the number of acres in each 40-acre tract that are irrigated. Too much emphasis cannot be laid upon the necessity of securing accurate and reliable data under this provision of the statute. Experience has shown that obtaining accurate and reliable data during a period covering one or two irrigation seasons, making a complete analysis of the same and presenting the results obtained in the form of a report embodying definite recommendations, will not only serve as a basis for the findings of the board, but will eliminate the taking of many hundred of pages of testimony, and, if fairly and impartially performed, will generally be acceptable to the water users.

The formality of court proceedings is eliminated in so far as practicable. The water users are permitted to come in and file their claims, and, in fact, are assisted in preparing the same if they so desire. In other words, those in charge of the adjudication work with the water users in an effort to have the claims presented so as to represent the actual conditions. The maps prepared by the State Engineer are available at the hearings, and the claims are checked with the map. If they do not correspond, arrangements are made to make further investigations and adjust the discrepancies. If claims are filed to which other claimants have objections, an opportunity is afforded to contest them, and testimony may be offered before the superintendent.

It may be added here that in these water-right determinations an effort is always made to conform the findings of the board to the general practice of irrigation on the stream, providing such practice does not involve a wasteful use of water to the extent that it cannot be justified as a beneficial use.

It may be said, therefore, that primarily the advantage of a water-right determination by the State Water Board lies in the fact that it may on its own initiative obtain any and all information which may be necessary or desirable in arriving at a determination of the relative rights of the respective water users on a stream or stream system. It determines all of these rights at one and the same proceeding, and therefore, has an opportunity of considering the relation of the various rights to each other.

Water-Right Certificate and Follow-Up System

It would be of little value to determine all existing rights if every new right that was initiated injected an element of uncertainty into the water-right situation, thus creating dissensions and opening the way for litigation. The Oregon water code provides for the initiation of water rights by the filing of applications in the office of the State Engineer and obtaining a permit thereon. Upon satisfactory proof that the water has been completely applied to the proposed use, a water-

right certificate is issued, as in the case of water rights which have been adjudicated by the state water board. However, it is obvious that if, after a permit was issued no further steps were taken to determine what progress was being made and the state engineer's office simply awaited the submission of final proof, it would soon be impossible to determine whether or not many of the permits were in good standing. For this reason a follow-up system has been adopted in Oregon whereby each permit holder files a report each year on a form attached to the permit, and in case no such report is filed he is notified by post card.

Double Purpose of Follow-Up System

This follow-up system serves a double purpose:

1. It keeps the records in the office of the State Engineer up to date, and an examination of these records indicates which permits are in good standing, and this in turn is of value in determining the amount of available water which may be appropriated by those desiring to initiate subsequent development. Without this follow-up system the records of water rights would soon be in the same chaotic condition that characterized water-right records prior to the enactment of the water code. That is to say, the records would merely show the filings that had from time to time been made, and would not indicate whether or not the rights had been perfected or were in good standing.

2. The follow-up system prevents the permittee from inadvertently allowing his rights to lapse through failure to begin the work within the time specified in the permit, or to prosecute the same with reasonable diligence, as required by the statute.

It is the duty of the administrative office having charge of the development of our water resources to assist in every practical way those who are endeavoring through their own efforts and expenditure of capital to develop these resources. It is the duty of those officials, and the water code offers to them a wide opportunity to work with those engaged in this line of development. Particularly is this applicable to the man who is endeavoring to irrigate his own holdings, which are generally small. It is in this that the follow-up system, by which the State Engineer's office keeps in touch with the status of permits, is of real service to the appropriator.

There is a marked distinction between a water right and water. It is essential that an adequate record of water titles be maintained, but it is also essential that the water users actually receive the water to which each is entitled. No water code would be complete unless it provided the necessary machinery for the actual delivery of water to those entitled to its use. The past history of irrigation has repeatedly shown that a man may have a prior right to the use of the water of a stream and yet be unable to secure water for the irrigation of his land, notwithstanding the fact that subsequent appropriators had an adequate supply. Injunctions sometimes have afforded the necessary relief, but are totally inadequate in cases where the distribution of the waters of a large stream is complicated by many diversions and users of water.

The Oregon water code provides for the appointment of a water master with full authority to distribute the water in accordance with the findings of the board or the decree of the court. The water master is allowed considerable discretion, however, in preventing the wasteful use of water. When the flow of a stream is not sufficient to reach a prior appropriator far down the stream, or it requires an excessive amount of water to provide him with that to which he is entitled, the water master either permits a subsequent appropriator higher up the stream to use the water or installs a rotation system whereby the entire flow of the stream is turned down for a short period of time to the prior appropriator, thereby eliminating much of the waste which would otherwise occur. By the use of discretion and diplomacy the water master is not infrequently able to make what would otherwise be an inadequate supply serve the entire district.

Irrigator's Time and Water Both Saved

It is a well known fact that much of the irrigator's time in the past has been taken up with a vain endeavor to prevent his neighbor from destroying his dam and taking the water to which he was, or thought he was, entitled. In fact, that has been a serious hindrance in many irrigation communities, and has led to much litigation and even to bloodshed. Not alone is the irrigator saved the time that it requires to protect and repair his dam and headworks, but also much time is saved by the distribution of water by rotation, which the water master encourages wherever practicable. It was very difficult indeed under the old plan for two or three neighbors to coöperate to the extent of using the water in turn, thereby irrigating their land in much less time and at much less expense. This was not due entirely to the inability of the neighbors to coöperate, but was due to a large extent to the fact that each water user felt that he would jeopardize his legal right to the use of the water unless it was used continuously throughout the irrigation season. This fear of legal complications is entirely eliminated under the Oregon water code, and it is an easy matter to show the water user the advantage he will gain by using the water by rotation.

It may be said, therefore, that distribution of water under the direction of a water master saves time, water and litigation.

At the time of the enactment of the Oregon water code considerable objection was encountered from large interests which apparently felt that their rights would be jeopardized by the state's supervision over its water resources. However, it now appears that this objection has entirely disappeared, and practically all water users find that through the administration of the water code they receive a real benefit.

The Oregon water code has served as a model for similar statutes in a number of our Western states. It is the only statute of the kind that has been passed upon and upheld by the Supreme Court of the United States.

I believe the Oregon water code and the irrigation district law are the two greatest assets which Oregon has in its irrigation development. The irrigation district law has placed irrigation as an enterprise on a sound business basis; this has been demonstrated by the results which have been obtained since its enactment. The water code makes it possible for a man with a water right to determine the exact nature and extent of that right, to record the same, and to secure actually the water to which he is entitled.

Shipping Board Protects Health of Shipyard Men

Sanitary Engineers Control Water and Food Supply, Housing, Sewerage and Garbage—Abate Flies and Mosquitoes

RECOGNITION of the health and contentment of workmen in the shipyards as a factor in the rapid output of vessels led the United States Shipping Board to create a department of health and sanitation, which was placed under an officer who received a free hand in carrying on the work as he saw fit. In a paper presented before the sanitary engineering section of the American Public Health Association, at its recent meeting in Chicago, this special work was reviewed by Lieut. Col. Philip S. Doane, director of the department.

A fundamental difficulty was encountered in the fact that shipyard employees are not under direct control, like soldiers and sailors, and are not obliged to carry out orders, while shipyard managements were so fearful of losing men that they would not issue orders likely to be objectionable to the men. Furthermore, while sanitary measures could be carried out without much trouble in the 11 yards operated by the board, the condition was very different in the other 160 yards working under contracts. None of these contracts calls for specific sanitary equipment, and only a few call for maintenance of sanitary and hygienic conditions. The shipyard health department, therefore, had to use diplomacy and to act largely in an advisory capacity, but Colonel Doane pointed out that in very few instances have the shipyards failed to follow out suggestions for improvements.

Sanitary engineers and medical officers were civilians, as no Army officials could be spared, and the major part of the work fell upon the engineers. To improve water-supplies, toilets and sewerage and other sanitary facilities, it has been necessary to have men constantly on the ground to assist and advise the engineers of the yards. As most of the yard employees live in neighboring cities and towns, the shipyard health department has endeavored to protect their home environment, with the assistance of local and state health authorities. Insanitary restaurants outside the yards have been condemned and replaced by restaurants conducted in a sanitary manner under the supervision of the local health officials.

Water-supply received special attention. Colonel Doane states that a thirsty man will drink, regardless of signs or instructions, "any water that is wet." Therefore, the policy adopted was that only pure drinking water should be supplied for washing and that outlets from industrial or fire protection mains should be of such type as to make it impractical or inconvenient to drink from them.

The importance of fire protection makes a dual system of mains the usual practice, and these were frequently connected, the only protection to the drinking water mains being a single gate valve. These connections have been mainly eliminated, and those absolutely necessary have two check valves with devices for frequent testing. Drinking water was at first distributed by buckets and common drinking cups, but the department has succeeded in having bubbler fountains installed in many yards.

Lavatories have been a source of much controversy. Methods of disposal of excreta and sewage are many in the average shipyard, owing to the waterside location, and the department's recommendations depended largely upon the character of the waterway at each yard. Care has been taken to secure collection of garbage in closed containers and its proper disposal. The collection and disposal of manure, and keeping the yards clear of refuse matter, have been included in the work.

Mosquito elimination was an important branch of the work, as the yards are often in proximity to swampy areas and the men must work in night shifts. The swamps have been drained and oiled. Flies were recognized as carriers of disease, and were trapped and destroyed, while measures were taken to control their breeding places. Eradication of vermin in barracks and living quarters introduced some problems, and at certain yards methods were adopted to solve them.

No public health officers was maintained by the City of Bath, Me., where there were two shipyards, and it was found that impure milk and meats were being delivered there. The city had no funds for such an official, but agreed to give all necessary authority if the department would pay the salary. A sanitary engineer, therefore, has acted as health officer for six months. He has secured pure milk and food supplies and has also improved general sanitary conditions.

The care of the thousands of men engaged in the construction of the barracks, hotels and houses for the shipyard employees has been another special branch of work. At Wyandotte about a thousand men were made ill by drinking water from the Detroit River, which Colonel Doane calls "diluted sewage." A temporary disinfecting plant was installed and a campaign was conducted to get the inhabitants to vote a bond issue for filters. This has been carried, although local opposition at first made this seem impossible.

The protection of the sailors also comes under the direction of the health department, which will supply each vessel with medicine chests and first-aid equipment. In the classes of instruction there will be a course on the use of this equipment. Colonel Doane's paper expressed high appreciation of the efficiency of the sanitary engineers' work.

Sewage-Treatment Project for Calumet District

A sanitary drainage district in the Calumet region of Indiana, to embrace the four industrial cities of Gary, Hammond, Whiting and East Chicago, having a combined population of about 150,000 is proposed. The sewage of these towns is now discharged through the Calumet River into Lake Michigan. The plan is to treat the sewage and reserve the flow so it will pass through the new Sag channel to the Chicago Drainage Canal. The sewage-collecting system of each city would remain under local control, but would deliver the sewage to a central or joint plant for treatment before its discharge into the river. No definite plans or estimates have been made and enabling state legislation will be required. C. B. Tinkham, Hammond, Ind., is head of a joint legal commission representing the four cities.

Comparison of Various Existing and Proposed License Laws

Form Suggested by Joint Committee of National Societies in 1915 Used as a Basis in Several States. Many Societies Are Working on Legislation

ENGINEERING societies in several states—Ohio, Minnesota, Wyoming, Iowa, Kentucky—have legislative committees at work on the preparation of engineers' license laws, and the subject is so important that various existing and proposed laws have been examined with the object of bringing together the principal features, for purposes of comparison. The states which now have laws regulating the practice of engineering or of surveying are Wyoming, Louisiana, California, Illinois, South Dakota, Idaho and Florida. Of the many states where licensing has been proposed, or where new laws are being advocated, those here considered are Pennsylvania, Indiana, California, Colorado, and Michigan.

The significant features of these bills are here given for comparison with the corresponding provisions in the suggested standard form of law to license all classes of engineers, as proposed in 1915 by a joint committee of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the Society of Naval Architects and Marine Engineers and the American Institute of Consulting Engineers. None of these societies, however, has given its official sanction to the committee bill, which in turn was modeled after a proposed bill written by a committee of the American Society of Civil Engineers in 1911.

The features which are here considered, in order, are: 1, Definitions, and scope of bills; 2, enabling clauses for permission to practice; 3, boards of engineering examiners; 4, qualifications of candidates, notice of examinations; 5, total fees for certificates, granting certificates without examination; 6, revocation and reinstatement, and 7, penalties, exemptions from application.

Definitions and Scope of Bills

1. The various laws differ in defining the practice of engineering and in their scope, as follows:

Joint Committee, Proposed 1915—A person practices professional engineering who practices any branch of the profession other than military engineering, including the design and supervision of construction of: Public and private utilities such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, wet docks, dry docks, ships, barges, dredges, cranes, floating docks and other floating property; steam engines, turbines, internal combustion engines and other mechanical structures; electrical machinery and apparatus, and works for the development and transmission or application of power; mining operations, processes and apparatus for carrying out such operations; municipal, irrigation, water-supply, sewerage, drainage, industrial, sanitary, hydraulic and structural works, and other public or private utilities or works which require such experience and technical knowledge as are required for admission to examination. It provides that this enumeration shall not be exclusive, and exempts contractors as follows:

"The execution as a contractor of work designed by a professional engineer, or the supervision of the construction of such work as a foreman or superintendent for such contractor, shall not be deemed to be the practice of professional engineering."

Wyoming, Passed 1907—Limited to engineers and surveyors who perform any field work preliminary to the preparation of an application for permits to use the water of the state, or who shall make surveys or do engineering work relative to the utilization or use of water.

Louisiana, Passed 1908, Amended 1914—Applies to civil engineers and surveyors only.

California, Passed 1909—Requires all county surveyors, or candidates for that office, to be licensed land surveyors.

Illinois, Passed 1915—Provides for licensing of structural engineers and was intended to relieve the disability which the Illinois law for licensing architects imposed upon them. Any person engaged in the designing or supervising of the construction, enlargement or alteration of any structures, other than buildings, or any part thereof, for others, and to be constructed by persons other than himself, shall be regarded as practicing structural engineering. By structures is meant all structures, other than buildings, having as essential features foundations, columns, girders, trusses, arches, and beams, with or without other parts, and in which safe design and construction require that loads and stresses must be computed and the size and strength of parts determined by mathematical calculation based upon scientific principles and engineering data. Certain structures designed solely for given engineering purposes, even though they may be buildings as defined in the act for licensing architects, are included in the term structures as defined. But it is stated that the act shall not "prevent any person, mechanic, or builder from making plans or specifications, or supervising the construction, enlargement, or alteration of any structure or building which is to be constructed by himself or his employees, and for his own use."

South Dakota, Passed 1913—Provides that county surveyors must be licensed, and that no survey is legal except when made by a licensed surveyor.

Idaho, Passed 1915—Licenses surveyors, and provides that no survey of land, plat or subdivision shall be legal unless made by a licensed surveyor.

Florida, Passed 1917—The definition of professional engineer in this law, which took effect Jan. 1, 1918, follows verbatim the Joint Committee bill, but it exempts persons acting as public officers for the state, county, or municipality on work where the estimated cost is $1000 or less. In all other provisions, except as noted

hereafter, this act duplicates the Joint Committee bill. Of the foregoing laws, the Florida act alone applies to all classes of engineers, while of the following proposed laws those for Pennsylvania, Colorado and California would include all engineers. Two states, Indiana and Michigan, have proposed bills to license architects and engineers under the same act.

Pennsylvania, Proposed 1914—This act was developed in preliminary form by a commission, appointed by the Governor of Pennsylvania, consisting of four members of the American Society of Civil Engineers and one member of the American Society of Mechanical Engineers. The introduction states the object to be: "To protect safety, life, health, and property by regulating the surveying, the designing, the supervision of construction, the operation and the maintenance of certain public and private works herein defined, providing a method of enforcing this act and providing penalties." The term "professional engineer" is defined to mean any person who practices professional engineering or any branch other than military engineering, including the designing or general supervision of construction or of the operation and maintenance of public or private works, such as railroads, railways, bridges, highways, canals, harbors, improvements to rivers and other streams, lighthouses, docks of all kinds, vessels of all kinds, dredges, cranes; also of appliances for the generation of power by stream, combustion, or electricity, or works for the development, transmission, or application of power; the design or general supervision of mining operations, or of the appliances, machinery, and apparatus connected therewith; also of municipal works of all kinds, the impounding and distribution of water for any purpose, sewerage, drainage, industrial, sanitary, hydraulic or structural works. The board shall determine from time to time what other branches shall be included in the foregoing enumerations.

Indiana, Proposed 1918 — Licenses architects and structural engineers, to include any person engaged in the planning, designing, or supervision of the erection, enlargement, or alteration of buildings or structures, or any part thereof for others, and to be constructed by persons other than himself. But draftsmen, students, clerks, or superintendents and other employees of those lawfully practicing as architects or structural engineers under licenses, are exempted. A similar provision to that in the Illinois law is made to exempt owners who build their own structures.

California, Proposed 1919—The definitions in this act, which has just been introduced into the state legislature, follow the Joint Committee very closely. It adds that the practice of professional engineering involves the control of forces of nature and the utilization of materials and these forces for the the benefit of man, and that certificates of practice will permit the holder to offer his services in consultation, in investigations, and for research work. It also adds telegraph and telephone systems and plants for the distribution of steam, water, gas, and other elements, and for heating and ventilating, to the list of mechanical structures. It includes the examination of mining properties and supervision of mining and metallurgical operations, and those of the oil industry. The execution as a contractor is exempted as in the case of the Joint Committee law.

Colorado, Proposed 1918-1919—Would define an engineer, without specific details, as a person who is engaged in the practice of the profession of engineering in any of its branches, except military engineering.

Michigan, Proposed 1919—Two bills have just been introduced into the legislature:

1. For the certification of engineers engaged as principals in "the design and erection of structural work for buildings and bridges; the measurement of streams; the location, design, and supervision of construction and maintenance of dams, river and harbor improvements; highways, railways, navigation canals, drainage and irrigation works, garbage-disposal plants, public sanitary systems, public water-works and municipal paving; and the making of surveys relating to property, political and geographical boundaries."

2. The other act provides for the registration of architects and engineers, although any person who has been qualified to use the title "registered architect" under the existing act may continue to use such title until Jan. 1, 1921.

Permission to Practice

2. The enabling clauses for permission to practice vary as follows:

Joint Committee—No person shall practice professional engineering without having first been duly and regularly registered, nor shall any person be permitted to testify or be accepted as qualified as an expert witness in professional engineering matters, unless duly registered; and every map, plan and drawing required by law to be certified or approved by a professional engineer shall be so certified by a regularly registered engineer.

Wyoming—This law, which is limited to engineers and surveyors having to do with the use of water, as above mentioned, requires that candidates must belong to one or more of the following classes: (1) Land surveyors, (2) topographic engineers, (3) hydraulic and hydrographic engineers, (4) construction and designing engineers, (5) administrative irrigation engineers.

Louisiana—Provides that any person, before entering the practice of civil engineering or surveying, must present to the Board of Engineering Examiners a diploma from an engineering college or school of good standing, such standing to be determined by the board, or shall pass a satisfactory examination before the board. Certificates must be recorded in the office of the clerk of the district court of the parish in which the applicant resides.

California—Three methods of licensing are contained in this law: By examination; by recommendation of three licensed surveyors; by the possession of a diploma from almost any technical school, the Board of Examiners being the judges as to the reputability of the school.

Illinois—After six months from the taking effect of the act, it shall be unlawful to practice structural engineering in the state without a license or to advertise or display a card or sign therefor.

South Dakota—According to this law no survey is legal except that made by a licensed surveyor.

Idaho—No survey of land, or plat or subdivision shall be legal unless made by a licensed surveyor, and all

surveys made under the authority of the state, or any county, town, city or village within the state, must be performed by a local surveyor. If the result of the examination of any applicant is satisfactory to a majority of the Board of Examiners, the applicant receives a license to practice structural engineering in the state, this license containing the full name, birthplace and age of the licensee.

The proposed laws which contain enabling provisions are:

California—After July 1, 1920, no person shall practice professional engineering without having first been duly and regularly registered.

Michigan—The first bill provides that after Oct. 1, 1919, before engaging as principal in any one or more of the branches of engineering specified, an applicant must qualify by examination in one or more of these specified branches, and the board shall certify all engineers qualifying under this section; the other bill provides that no person shall use the title "registered architect" or "registered engineer," or any variation of the same, or use any word, letter or device to indicate that the person using same is so registered, after 90 days subsequent to the passage of the act, without being registered in accordance therewith. Certificates shall indicate the character of work for which the registrant is qualified.

State Board of Engineering Examiners

3. Nearly all the bills provide for a board of examiners, generally either of nine or five members, as follows:

Joint Committee—A State Board of Engineering Examiners shall consist of nine members, to be appointed by the Governor, the first appointments to be made at three regular intervals, as specified, the regular term of office thereafter to be six years. The Governor may remove any member for misconduct, incapacity or neglect of duty. Each member shall be a professional engineer of at least 10 years' active experience and recognized standing in his profession, shall be at least 35 years old, and shall have been a resident of the state for at least one year immediately preceding his appointment. Except the first appointees, each member shall also be a registered professional engineer.

The members shall serve without compensation except for traveling and other necessary expenses. The board is entitled to the services of the Attorney General, and can compel the attendance of witnesses, and may take testimony and proofs pertaining to all matters within its jurisdiction. The board shall appoint a secretary, not a member of the board, but who shall possess the qualifications required for members thereof. The secretary shall hold office during the pleasure of the board and receive a specified annual compensation. The board shall hold at least six stated meetings each year, and special meetings as its bylaws may provide. At meetings held solely for the examination of candidates for registration, three members shall constitute a quorum. At all other meetings, a majority shall constitute a quorum. The board shall have power to employ clerks and other employees, and to rent offices as may be necessary to the proper performance of its duties.

The Board of Examining Engineers in Wyoming consists of the State Engineer and two engineers of thorough training and experience, appointed by the Governor and serving without compensation.

Louisiana—The Board of Engineering Examiners consistes of five members, three of whom shall constitute a quorum, all required to be practicing civil engineers or surveyors in good standing. Members are appointed by the Governor for a term of six years, from a list presented by the Louisiana Engineering Society; the Governor has the right to remove any or all members for inefficiency or neglect of duty, and to fill the vacancies occurring in the board from names recommended by the same society.

Illinois—The State Board of Examiners of Structural Engineers is composed of five members, one a professor in the civil engineering department of the University of Illinois, and the others structural engineers of recognized standing, of not less than 10 years' practical experience, and practicing as structural engineers in Illinois. The regular term of office is four years, and candidates are appointed by the Governor. A secretary receives a salary fixed by the board, not to exceed $1,500 per annum, together with traveling and other expenses. The members of the board receive the sum of $10 for each day actually engaged in the performance of their duties, together with legitimate expenses. Three members constitute a quorum. The board's rules and regulations for the examination of applicants must be published at least twice in one engineering journal of general circulation in the state, and one daily newspaper, together with the name and address of each officer. At least two examinations are held each year.

South Dakota and Idaho—Applications for licenses are made to the State Engineer, who alone has power to grant licenses to practice land surveying.

Florida—The State Board of Engineering Examiners consists of five members appointed by the Governor, three of whom are civil engineers, one a mining or electrical engineer, and the other a mechanical engineer or naval officer. The regular term of office is four years, and the Governor may remove any member for misconduct, incapacity or neglect of duty. Each member of the board must be a professional engineer of at least 10 years' active experience, of recognized good standing in the profession, at least 35 years of age, and have been a resident in the state for three years immediately preceding his appointment. Each member must be registered as a professional engineer, and be also a member in good standing of a recognized engineering society.

Members serve without compensation, except traveling and other necessary expenses. The board is required to hold at least two regular meetings each year and has power to employ clerks and other employees and rent offices, as may be necessary, for the proper performance of its duties.

The proposed bills provide for examining boards as follows:

Pennsylvania—The State Board of Examining Engineers would consist of nine members appointed by the Governor, each member serving for a term of six years except those first appointed, of whom three shall be appointed for two years, three for four years, and three for six years. Each member of the board shall be a professional engineer of at least 10 years' active experience, and have the qualifications demanded of the

highest grade membership in one of the four national engineering societies, and must be at least 35 years of age, having been a resident of Pennsylvania at least five years immediately preceding his appointment. After the first appointees, the members must be registered professional engineers.

They shall serve without compensation, except expenses actually incurred in the performance of duty. The secretary is a member of the board, he is appointed by it and holds office during the pleasure of the board, and shall receive an annual compensation of $3600. The board shall hold at least six stated meetings annually in Harrisburg, five members to constitute a quorum.

Indiana—The State Board of Examiners of Architects and Structural Engineers would be composed of five members, not more than three of whom shall be of one political party, two shall be architects and two shall be structural engineers, and one shall be neither an architect nor a structural engineer. All shall be residents of Indiana, in good standing, and the professional members shall have been engaged in independent practice for at least five years. The regular term of office shall be five years. Appointments are to be made from a recommended list of five architects and five structural engineers from the Indiana Society of Architects and the Indiana Engineering Society, respectively, except the member who is neither an architect nor a structural engineer. Regular meetings shall be held in January, April, July and October of each year; three members shall constitute a quorum. The board is to adopt rules and regulations for examinations and publish the same in one daily newspaper in Indiana at least twice. Examinations shall be held at least twice each year.

California—Provides a State Board of Engineering Examiners in accordance with the Joint Committee bill, the first appointments to be made for two, four and six years.

Colorado—The Governor appoints a State Board of Engineer Examiners, composed of five members, legal residents of the state, who have been engaged in the practice of engineering at least 10 years. The State Engineer is ex officio the fifth member of the board Members of the first board receive a certificate of appointment to entitle them to a license. Successors are appointed for a term of four years from a list of five nominees elected by the licensed engineers acting in a general assembly called for this purpose in January next preceding the expiration of the terms of any members. The State Engineer acts as secretary and treasurer.

Members shall serve without compensation other than necessary expenses, to be paid from the special "Engineer Examiners' Fund" obtained by the fees derived from the operation of the act.

Michigan—(1) The board shall consist of three representative engineers who have been residents of the state not less than five years and engaged in one or more of the specified branches of engineering not less than 10 years. After Oct. 1, 1919, only registered engineers are eligible. The Governor shall appoint one member from the upper peninsula, one from that portion of the southern peninsula lying north of the Michigan base line and one from that portion of the state lying south of the Michigan base line. The terms of office shall be six years. Members are to receive $25 per day, with ... penses. (2) The other bill provides that the Gover... shall appoint a board of five examiners, composed of t... architects and three engineers, who have been in acti... practice of their professions as principals for not les... than 10 years, and who are otherwise qualified, one o... them to be from the upper peninsula. Not more than one engineering member shall belong to any one of the five major classes of engineers—civil, mining, mechanical, electrical, and chemical. No person shall be appointed except upon the indorsement of not less than 25 practitioners of recognized standing in the profession he is to represent. The regular term of office is five years. Meetings are to be held twice each year. Members of the board receive no compensation, except actual expenses.

Qualifications of Candidates—Examinations

4. In specifying the qualifications of candidates and providing for examinations, the various acts require:

Joint Committee—Admission to examination is allowed to any candidate who pays a fee of a sum to be specified and submits evidence satisfactory to the board that he is more than 21 years of age, is of good character, and has been engaged upon engineering work for at least six years, during which period he has had charge as principal or assistant for at least one year; or that he is a graduate from an engineering school of recognized reputation and has been engaged upon engineering work for at least four years, having had charge as principal or assistant for one year. Scope of examinations and methods of procedure shall be prescribed by the board; examinations may be either oral or written, or partly oral and partly written. The secretary of the board shall notify each candidate of the result of his examination.

Wyoming—The board may satisfy itself by conducting examinations or by investigation of the records, training and experience of those who desire to qualify. The moral character of the applicant is investigated, and no license is issued to one who is incompetent, dishonest, intemperate or addicted to any habit that would, in the judgment of the board, render him an unsafe employee.

Louisiana—A satisfactory examination, for which a fee of $10 is required, shall be passed upon the following: For surveying—geometry, trigonometry, land surveying, practical use of instruments; for civil engineering—the same as for surveying, and in addition thereto, natural philosophy or physics, including practical problems in design and construction. The applicant must be 21 years of age, of good moral character, and possess at least a fair primary education.

South Dakota—Requires a $15 fee to become a candidate, $5 to be returned if the candidate fails to pass the examination. Any practicing surveyor of 10 years' experience, with testimonials satisfactory to the State Surveyor, receives a certificate without examination.

Idaho—The application shall be referred to a member of the Board of Examining Surveyors, who will make such examination as to the applicant's fitness for license as he may deem necessary, certify the result to the State Engineer, and the latter will then notify the applicant.

Illinois—Examinations shall be held according to rules of the board, a majority constituting a quorum, or by a committee of two or more members elected and appointed by the board. These examinations are conducted by written or printed interrogatories, in whole or in part, and each applicant must sustain "a satisfactory examination in the design and construction of buildings and structures according to scientific principles and with special reference to strength and safety; the strength and properties of various building materials; the principles of theoretical and applied mechanics; the ability of the applicant to apply his knowledge to ordinary requirements of structural engineering, and in such other matters and subjects as the board may require."

A fee of $20 is required of the applicant, who must submit proof, by affidavit or otherwise, that (a) at the time of taking effect of the act he was actually engaged in the practice of structural engineering in the state and did not apply for a license without examination, in which case the applicant shall be entitled to an examination without regard to the number of years he has practiced; or (b) that within 10 years next prior to his application he has practiced structural engineering in some state or territory of the United States or some foreign country for not less than six years, during at least two full years of which he shall have been in responsible charge of work as principal or assistant; or (c) that within 10 years next prior to his application he has pursued a course of study and training in the theory and practice of structural engineering covering at least the subjects above enumerated, for a period of not less than six years in the employ or under the supervision of practicing structural engineers, during at least two years of which he has been in charge of work in designing or construction, in the employ or under the direction of such engineers. Graduation from a school or college of engineering considered to be in good standing by the board, having a course of study not less than four years, during at least thirty weeks each year, shall be credited two years upon the six-year period. The board may adopt rules in its discretion for the case of students who have pursued the course of instruction but were not graduated from schools or colleges of approved standing.

Provisions for qualifications of candidates and examinations in proposed bills are as follows:

Pennsylvania—Qualifications for applicants are prescribed similar to those in the Joint Committee bill.

Indiana—Any person of good moral character over 21 years of age, upon payment of a fee of $20, shall be entitled to an examination. Examinations for architects shall have special reference to the planning, designing and construction of buildings or structures, and their sanitation, and include a test of the candidate's knowledge of the strength of materials and their properties, with special reference to their strength and safety, and of his ability to make practical application of such knowledge in the ordinary professional work of an architect, and in the duties of supervisor of mechanical works in a building or structure; also such other subjects as the board may require from time to time. Examinations for structural engineers shall have special reference to design and construction of buildings or structures according to scientific principles as above; the principles of theoretical and applied mechanics; the ability of the applicant to apply his knowledge to ordinary requirements of structural engineering; also other subjects as the board may require.

California—Same as the Joint Committee bill.

Colorado—Examinations shall be given to the candidate only in that branch of engineering in which he is proficient, as set forth in his application. The board has authority to summon any engineer holding a license to assist in preparing for and conducting examinations of candidates, such engineers being remunerated, at not to exceed $10 per day, in addition to necessary expenses. The board admits to examination any candidate who pays a fee of $10, is a citizen of the United States more than 25 years of age, of good moral character, and who has been actively engaged in the practice of engineering at least 10 years in the employ of practicing engineers. Each complete year as a student in an engineering school of recognized reputation shall be credited as one year of practice. During six years he must have been in active responsible charge of engineering work. Responsible charge is held to mean the actual supervision and direction of engineering work requiring the exercise of initiative, judgment and independent decisions, and may be performed in the capacity of either principal or assistant.

Michigan— (1) Applicants for examination must satisfy the board that they have had not less than six years of practical experience in one or more branches of engineering as specified, or shall have been graduated in engineering from a recognized school or college of engineering, and have had in addition not less than two years of practical experience. After Oct. 1, 1919, practical experience means work performed as a subordinate under the supervision of one or more certified engineers; (2) The second bill provides that the board shall adopt rules and regulations for the examination and classification of candidates for registration, and the issuance of certificates thereto. Any person of legal age and good moral character, upon payment of a fee of $10, may apply for examination.

Total Fees—Certificates Without Examination

5. The total fees for certificates, and provisions for licensing upon the passage of the act, and for licensing engineers from other states without examination, are as follows:

Joint Committee—Upon receipt of an additional fee, amount to be specified, the board shall issue to any applicant who has passed the examination a certificate of registration which authorizes the applicant to practice engineering. The board shall examine requirements for registration in other states, territories, and countries, and record those which it believes has standards not lower than those provided for the state. Persons holding certificates of such states are to be registered upon payment of a specified fee.

Provision is made for registration without examination by issue of certificate before a specified date to any candidate who has practiced professional engineering at least 10 years immediately preceding the date of application, and has had charge as principal or assistant for at least two years.

Wyoming—A fee of $5 is required before the issuance

of a license, which license is signed by the president of the board and attested by the secretary under his seal.

Louisiana—Persons practicing civil engineering or surveying in the state before the passage of the act are allowed 90 days to register with the clerk of the court of the district in which they reside. The Board of Examiners must publish annually in February a complete list of registered civil engineers and surveyors in a daily paper of the City of New Orleans, this list being received as evidence in court that the names it contains are duly registered. The annual fee is $3 for civil engineers and $1 for surveyors if paid before Feb. 1, but $10 and $5, respectively, after that date.

Illinois—If the result of the examination is satisfactory, the applicant receives a license to practice structural engineering, upon payment of the further sum of $30. Any person who could show that he was a resident of the state and engaged in the practice of structural engineering on the date of the taking effect of the act, is entitled to a license without examination, provided such application be made within six months after the taking effect of the act, and a fee of $50 be paid. Also, for a fee of $50 the board may issue without examination a license to practice to a structural engineer who has been licensed under the laws of any other state or territory, or foreign country, provided it appear to the board that the requirements in such countries were equal to those prescribed in Illinois, and that such countries would afford a like privilege to structural engineers who hold Illinois licenses. The Secretary of State is to receive a fee of $1 for the recording of each license filed for record. Every licensed structural engineer shall have a seal, the impression of which must contain the name of the engineer, his place of business, and the words "Licensed Structural Engineer—State of Illinois," with which he must stamp all plans, drawings and specifications issued by him for use in the state.

Idaho—License is issued to a successful candidate upon submitting to the State Engineer a $500 bond, $5 fee and official oath. The bond must be a surety company bond. Under the provisions of this statute all persons who are graduates of a course of civil engineering from the University of Idaho may receive a license without examination, upon their own application.

Florida—The additional fee prescribed, as in the Joint Committee bill, is $10. Provision is made for engineers from other states also, as in the Joint Committee bill, the fee being $25. For this same fee, $25, practicing engineers received certificates before Dec. 1, 1917.

The provisions in various proposed laws are:

Indiana—Required, fee of $30 and certificates allowed to be issued to engineers who can show that they were engaged and in good standing in the practice of architecture or structural engineering on the date of the passing of the act, provided such applicant should show that he was in good repute in the practice of his profession. A certificate may also be issued without examination, upon payment of a fee of $50, to an architect or to a structural engineer licensed under the laws of any other state or territory, or of any foreign country, provided it appears to the board that such places have requirements for license equal to those required in Indiana.

California—Certificates of registration are issued upon payment of an additional fee of $20, and the provisions for registering outside engineers and those who are practicing engineering at the time of the passing of the act, are similar to the requirements of the Joint Committee bill.

Colorado—Successful candidates receive certificates upon payment of a fee of $5. Those engaged in the practice of engineering at the time of the passage of the act are entitled to a license without examination upon payment of $15, provided that they have made such application within six months after the taking effect of the act.

Michigan—(1) For each initial certificate the fee is $10; for each subsequent annual renewal of certificate, issued by the board upon request of certified engineers, the fee is $5. Up to Oct. 15, 1919, the certificates are issued by the board upon a sworn statement of the applicant setting forth in full his training and experience and showing that he has been engaged as a principal in engineering for a period of not less than two years prior to Sept. 30, 1919. The board may permit engineers of other states and of foreign countries to engage as principals within the state when they present credentials showing that they have qualified for such work under appropriate laws of their own states or governments; (2) The other bill provides that in addition to the fee of $10 paid for certificate, a fee of $2 must be paid each year for the issuance of a renewal certificate. Any person engaged in the practice of engineering as a principal under the title of engineer before the passage of the act, having presented proof of competency and good character, may secure a certificate to use the title "registered engineer." Provision is made to permit architects and engineers of other states and foreign countries to practice architecture and engineering when they present credentials as in the case of bill (1).

Revocation and Reinstatement

6. Provisions for revocation and reinstatement are made as follows:

Joint Committee—Provides that the board may revoke a certificate of registration for fraud or deceit in practice or in the obtaining of the certificate or for the conviction of crime. Proceedings for revocation shall be begun by filing with the board written charges against the accused. These charges may be preferred by any person or corporation, or the board may on its own motion direct its secretary to prefer charges. The board shall designate not less than three of its members a committee to hear and determine said charges at a time and place to be fixed by the committee, and a copy of the charges shall be served upon the accused or his counsel at least 10 days before the date fixed. A two-thirds vote of all the members of the board shall be necessary for revocation. The board may reissue a certificate of registration to any person whose certificate has been revoked only after the expiration of one year from the date of the revocation, and for reasons which the board shall by a two-thirds vote of all its members determine to be satisfactory.

Wyoming—Licenses may be revoked if the character of the work or the moral fitness of the holder be judged as insufficient.

Louisiana—Licenses may be revoked upon conviction of immoral conduct before any competent court, and if the renewal license fee is not paid before Feb. 1 of each year.

Illinois—Any license may be revoked by a four-fifths vote of the State Board of Examiners for gross incompetency, or recklessness in the construction of buildings or other structures, or for fraudulently affixing seal to plans, drawings or specifications, or for any dishonest practice on the part of the holder, or for fraud in obtaining the license or practicing without payment of the annual license renewal fee. Provision is made for the holder to have at least 20 days' notice of the charge against him, of the time and place of the meeting of the board for the hearing and determining of such charge. The Circuit Court judges receive power to compel the attendance of witnesses upon the deliberations of the board. After one year, the board receives power to reinstate a petitioner according to its own rules and regulations, but it may require the petitioners to submit to an examination. A majority vote of the board is sufficient to reinstate.

Idaho—The State Engineer shall revoke surveyors' licenses upon the recommendation of a majority of the Board of Examiners for: (1) Failure to keep in force and effect the bond filed with the State Engineer; (2) gross incompetence, or fraudulent, dishonest, or unprofessional conduct on the part of the licensee in the conduct of his professional business.

Pennsylvania—Provides for revocation upon proof of fraud or deceit in obtaining registration, or in the practice of professional engineering; conviction of the crime of perjury, or larceny, or embezzlement or false pretense, or robbery, or burglary, or bribery, or corrupt solicitation, or forgery. It requires one month's written notice of the time and place of hearing, and the decision is not valid except by the vote of at least six members of the board. Reinstatement is allowed one year after revocation, provided six members of the board shall approve.

Indiana—Provides for revocation of license by a majority vote of the board, for incompetency or recklessness in the design of buildings or structures, or for dishonest practice or practices on the part of the holder. Twenty days' written notice is required. After the expiration of six months a person may have a new license issued to him, upon satisfactory evidence of proper reasons for such reinstatement and upon payment of $15. Dishonest practice is defined as follows: (1) To be guilty of fraud or misrepresentation in obtaining the license; (2) to conspire or attempt to conspire with any other person to violate the building or sanitary laws, and (3) to give or accept any valuable consideration as a bribe.

California—Exactly similar to the Joint Committee bill.

Colorado—The board shall receive power to inquire at any time into the identity of a person claiming to be a licensed engineer, and may revoke the license by a four-fifths vote in case the practitioner is guilty of any fraud or deceit in his practice, or is guilty of fraud or deceit by which he was granted a license, and if he is incompetent.

Michigan—(1) The board may revoke certificates for incompetence or dishonesty; (2) the other bill provides for revocation after 30 days' written notice and after a hearing, upon proof that the certificate was obtained by fraud or misrepresentation or that the holder has been guilty of malfeasance or gross incompetency in practice.

Penalties—Exemptions from Application

7. Penalties for violation, and exemption from the application of the laws are provided as follows:

Joint Committee—Violation by practicing without complying with requirements of the act is classed as a misdemeanor. The act, it is stated, shall not apply to any professional engineer working for the United States Government, nor employed as an assistant to a professional engineer registered under the act, nor to any engineer coming from without the state and employed therein until a sufficient time, prescribed by the rules of the board, shall have elapsed to permit registration—provided that before practicing within the state he shall have applied for the issuance to him of a certificate of registration and shall have paid the fee prescribed for admission to examination. The bill also suggests that a specified appropriation should be made for the use of the board for the payment of salaries and expenses under the act.

Louisiana—Violators of the act shall be fined not less than $25 nor more than $100, or they shall be imprisoned not less than 30 nor more than 90 days for each offense, by any court of competent jurisdiction. This does not apply to engineering departments of the United States, nor to civil engineers and surveyors of other states and territories when in actual consultation with registered civil engineers or surveyors of Louisiana, nor to any civil engineer or surveyor of the state actually practicing his profession before the passage of the act.

Illinois—Provides that any person guilty of the violation of its provisions shall be punished by fine of not less than $10 or more than $200 for each and every offense. It applies to structural engineers only.

Florida—Similar to the Joint Committee bill, and further provides that it shall not apply to any architect registered by Florida under the provisions of the act creating a State Board of Architecture.

The proposed bills contain the following penalties:

Pennsylvania—Any person shall be guilty of a misdemeanor who shall violate any provisions of the act, and upon conviction thereof he shall be sentenced to pay a fine not exceeding $1000 or undergo an imprisonment not exceeding one year, or both. The exemptions in application are prescribed as in the Joint Committee bill.

Indiana—Provides that after six months from the date when the law becomes effective it shall be a misdemeanor, punished by a fine of not less than $10 or more than $500 for each and every offense, for any person to practice architecture or structural engineering in Indiana without a license, or put out any sign, or card, or other device. The board shall cause the prosecution of all such persons violating the act.

California—Precisely similar to the Joint Committee bill.

Colorado—Violation is punished by a fine of $500 or by imprisonment of not more than six months, or both. It provides that nothing in the act shall be construed

to limit the rights, privileges and duties of architects licensed to practice under the architects' license law in Colorado.

Michigan—(1) Any person who fails to comply with the provisions of the act shall be ineligible for appointment or election to any state, county, township, city, village or other public office, where the duties involve one or more of the branches of engineering specified. Any person who engages in these branches of engineering except under a certificate shall be subject to a fine of $100 for the first offense, $500 or imprisonment for one year, or both, in the discretion of the court, for each and any subsequent offense. Plans, specifications, and estimates for all public work involving engineering must be prepared by certified engineers; (2) The other bill provides that any violation of its provisions shall be a misdemeanor, punishable for the first offense by a fine of not more than $100, and for subsequent offense by a fine of not more than $500, or imprisonment for not more than one year, or both. This act would repeal the act providing for the registration of architects, and all moneys remaining in the state treasury as a separate fund shall be transferred to a corresponding fund provided for by the new act.

Tests Show High Shears in Deep Reinforced-Concrete Beams

Preliminary Studies Made For Emergency Fleet Corporation's Concrete Ship Work Point to Desirable Higher Safe Units Than Those Now Permitted

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PUBLISHED tests of reinforced-concrete beams have shown shearing strengths in the neighborhood of 100 to 150 lb. per square inch for beams with no web reinforcement, and seldom exceeding 300 lb. per square inch for beams with the most effective web reinforcement. Based on these tests, standards for design have been formulated and widely accepted which allow generally about 40 lb. per square inch working stress in shear for a beam with no web reinforcement, and a maximum of around 60% of the compressive strength of the concrete for beams having the most effective web reinforcement. Recent tests made for the Emergency Fleet Corporation in connection with the design of concrete ships indicate that for deep beams, at least, these values are much too small.

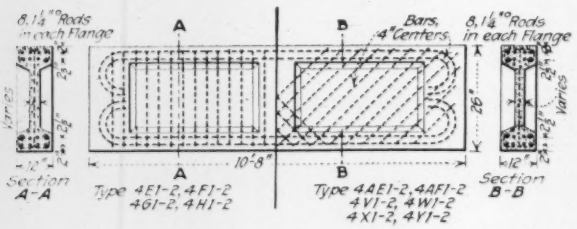

FIG. 1. TWO TYPES OF DEEP BEAM TESTED IN SHEAR
See table on p. 432 for further dimensions

For determining web reinforcement the following formulas have been almost universally adopted: $T = Vs/jd$ (for vertical stirrups); $T = \frac{2}{3} \times 0.7\ Vs/jd$.
In which T = total load carried by one stirrup;
V = total shear on the section considered;
s = spacing of stirrups in the direction of the axis of the beam;
jd = moment arm of the resisting couple.
The maximum spacing of stirrups generally has been limited to values ranging from about $\frac{3}{4}\ jd$ to as much as jd.

The most obvious difficulty in designing a reinforced-concrete ship under existing standards was early found to be that of securing sufficient shearing strength without an undue weight of concrete in the shell. This led to the carrying out of a series of tests on beams designed to meet as far as practicable the conditions existing with a ship in service. The test beams were relatively deep compared to the span. The web thicknesses used (generally 3 or 4 in.) were such as seemed practicable for a ship. The heavy flanges used were necessary to enable sufficient longitudinal reinforcement to be used to carry the bending moment when a high shearing stress was present. At the same time, they may be considered to represent conditions which occur at the gunwale and at the bilge where there are large concentrations of reinforcement.

Heavy pilasters at the load-point and at the supports were necessary to prevent crushing of the web, due to the concentrated load at these points. From the phenomena of the tests it is apparent that an appreciable portion of the load was carried directly by the frame action of the heavy pilasters and flanges which were built monolithically with the beam. This portion of the load would not go to increasing the shearing stress in the web, and for an accurate measurement of the shear in the web it is necessary to make a correction for this load. However, the effect of the heavy frames in a ship will be somewhat analogous to that of the pilasters in the test beams. In structures other than ships (such as girders for railway or highway bridges), where high working stresses in shear would be advantageous, there usually will be present features which are analogous to the pilasters of the test beams.

The first series of tests for the Concrete Ship Section of the Emergency Fleet Corporation was carried out at the Pittsburgh laboratory of the Bureau of Standards. Thirteen beams 4 ft. 4 in. high and 18 ft. 6 in. long, and one beam 10 ft. high and 22 ft. long were tested in this series. These tests afforded a basis for concluding that the high working shearing stresses used in the design of the first Government concrete ship were safe. Also, as a result of these tests, tentative standards for shear design for concrete ships were drawn up. However, certain features needed more thor-

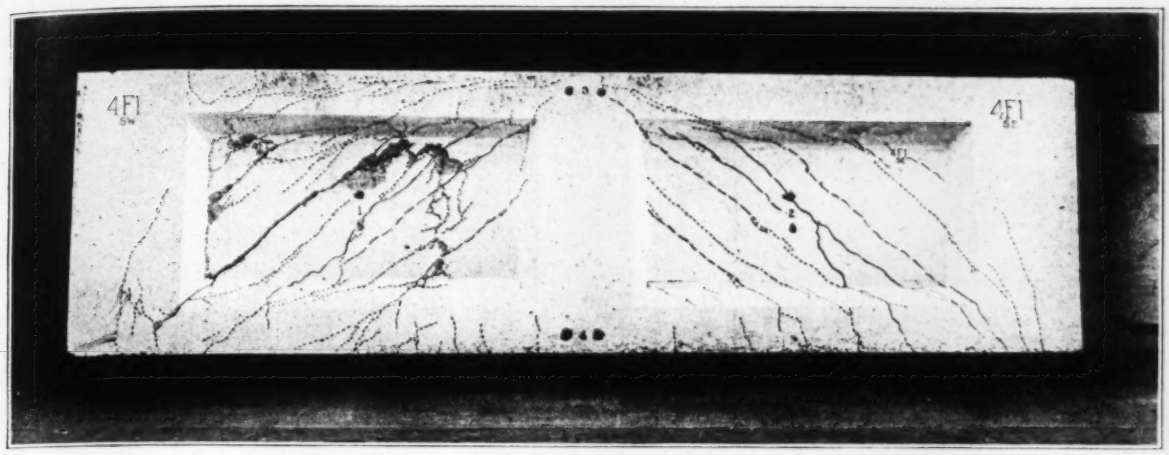

FIG. 2. SHEAR CRACKS IN DEEP CONCRETE BEAM TESTED FOR CONCRETE SHIP WORK
Solid lines cracks under 400 lb. per square inch shear. Dashed lines cracks under 800 lb. per square inch shear. Dotted lines cracks under maximum load

ough examination, and a second series of tests was laid out which covered a much wider range of conditions than those involved in the Pittsburgh specimens.

This second series of tests was carried out in the Fritz Engineering Laboratory at Lehigh University, Bethlehem, Penn. The full use of this laboratory, without charge, has been given to the Emergency Fleet Corporation for this work, and the university officials have coöperated freely in making the work successful.

These beams were 10 ft. 8 in. long and 36 in. deep, 12 in. wide at flanges and of varying web thickness. All the beams were of I-shaped cross-section, with eight 1¼-in. round bars for longitudinal reinforcement in the top and in the bottom. The form of the beams and the manner of reinforcement are shown in Fig. 1. The reinforcing bars were of steel rejected from shrapnel manufacture, and had a yield-point stress of approximately 60,000 lb. per square inch. All the web reinforcement was of round bars of the sizes given in the accompanying table. They were spaced at distances of 4 in. in a direction normal to the axis of the bar in all cases. They were hooked over the longitudinal reinforcing bars at the top and at the bottom of the beam, but were not welded in any instances. The beams were tested at an age of about 60 days, and 8 x 16-in. control cylinders made with the beams were tested at the same time. The strengths of the control cylinders are shown in the table.

Fig. 2 is a view showing the appearance of a typical beam after failure. The cracks in the beam were painted to make them visible in the photograph and to distinguish these occurring at different loads. The cracks shown as solid lines were present when the shearing stress was 400 lb. per square inch. The dashed lines represent cracks at 800 lb. per square inch shear, and dotted lines those at the maximum load carried by the beam. The holes in the concrete were made to expose the steel for purposes of strain-gage readings. Due to the painting of the cracks in Fig. 2, their prominence is exaggerated; that this is so is indicated in Fig. 3, a view of beam 4F2. This beam is a companion specimen of 4F1, shown in Fig. 2. The photograph was taken at the end where failure occurred and without first having the cracks painted.

Fig. 4 shows the observed stresses, center deflection and average widths of the largest cracks for a typical beam. In this diagram tension stresses were plotted upward and compression stresses downward. The numbers on the curves refer to gage lines shown in Fig. 2. Gage lines 5 and 6 were in positions corresponding to the positions of gage lines 3 and 4, respectively, but were on the opposite side of the beam.

Fig. 4 gives an idea of the behavior of a typical beam during the test. Attention is called to the regularity of the curve showing maximum crack widths. The first point on this curve indicates the first measurement of crack width. The dotted line indicates the origin for this curve and does not indicate the crack width for loads below the first point.

The deflection shown is larger than is accounted for by flexure alone. This will be seen if the stresses for gage lines 3 and 5, and 4 and 6, all of which were on reinforcing bars, be reduced to unit deformations and applied in the deflection formula:

$$D = 0.833 \frac{l^2}{d} (e_c + e_s)$$

in which D = deflection
l = span
d = vertical distance between measurements
e_c = unit deformation in upper bars
e_s = unit deformation in lower bars

An examination of G. A. Maney's article in the "Proceedings" of the American Society for Testing Materials, 1914, p. 311, shows the substantial correctness of this formula for beams in which the shearing deflection is negligible. The indication is that the high shearing stress developed and the opening of diagonal cracks had an important effect on the deflection.

Test results for a few of the beams of this series are given in the table. The shearing stresses given in the table are based on the assumption that all the load was carried by flexure of the beam as a whole, and, consequently, that all the shear passed through the web of the beam. This must be somewhat in error, because with

TABLE SHOWING RESULTS OF TESTS OF REINFORCED-CONCRETE BEAMS

Beam No.	Web Reinforcement Type	Web Reinforcement Diameter of Bar, In.	Web Thickness, In.	Maximum Load Lb.	Deflection at Maximum Load, In.	Cylinder Strength, Lb. per Square Inch	Stress at Maximum Load, Lb. per Square Inch: Shear	Tension In Stirrups Observed		Tension, In. Longitudinal Bars: Observed	Tension, In. Longitudinal Bars: Computed	Crack Width at 40% [illegible] Per Square Inch Shear
4E1	Vert.	⅜	3 16	360,800	0 41	6,020	1,963	43,400		38,000	35,350	0 002
4E2	Vert.	⅜	3 44	317,000	0 33	5,930	1,563	38,600		33,000	31,100	0 005
4F1	Vert.	½	2 91	340,600	0 37	5,800	1,985	50,000		32,000	33,400	0 003
4F2	Vert.	½	3 22	303,000	0 33	5,610	1,649	55,800		32,000	29,700	0 007
4G1	Vert.	¼	3 19	306,300	0 36	5,370	1,630	.....	Y.P.	34,000	30,000	0 009
4G2	Vert.	¼	3 12	270,400	0 36	5,730	1,470	.....	Y.P.	27,000	26,500	0 002
4H1	Vert.	⅛	3 25	256,800	0 34	5,120	1,340	.....	Y.P.	28,000	25,200	0 009
4H2	Vert.	⅛	3 53	261,500	0 33	6,730	1,257	.....	Y.P.	30,000	25,600	0 009
4J1	None		3 00	168,000	0 26	4,930	949	.....		13,000	16,450	0 026
4J2	None		3 34	187,500	0 30	5,820	952	.....		19,950	18,400	0 022
4V1	Diag.	¼	3 31	419,900	0 32	4,720	2,150	.....	Y.P.	41,000	41,100	0 001
V42	Diag.	¼	3 00	433,200	0 32	5,520	2,470	.....	Y.P.	40,900	42,400	0 001
4W1	Diag.	¼	3 34	337,600	0 30	4,840	1,715	.....	Y.P.	30,000	33,000	0 001
4W2	Diag.	¼	3 09	370,500	0 38	6,180	2,060	.....	Y.P.	33,000	36,350	0 001
4X1	Diag.	⅛	3 38	313,500	0 34	4,340	1,575	.....	Y.P.	28,000	30,650	0 007
4X2	Diag.	⅛	3 00	330,000	0 29	5,860	1,880	.....	Y.P.	28,100	32,300	0 001
4Y1	Diag.	¼	3 34	261,100	0 32	5,040	1,325	.....	Y.P.	23,500	25,600	0 004
4Y2	Diag.	¼	3 03	268,700	0 28	5,420	1,520	.....	Y.P.	33,000	26,350	0 003
4AD1	Diag.	⅛	0 00	148,300	0 40	4,460		.....	Y.P.	25,000	14,500	
4AE1	Diag.	⅛	2 06	258,000	0 20	4,650	2,120	.....	Y.P.	19,500	25,300	0 001
4AF1	Diag.	⅛	4 25	306,300	0 24	4,380	1,225	.....	Y.P.	33,500	30,000	0 002
4AG1	None		0 00	77,600	0 49	5,540	.....	.....		20,000	7,600	
4AG2	None		0 00	65,000	0 45	5,860	.....	.....		24,000	6,350	

For cases in which the stress in the stirrups had passed the yield-point it is so indicated in the table by the initials Y.P.

the monolithic construction of the beam the flanges and pilasters would act as a frame to some extent independently of the beam structure, and would carry loads which did not have to pass through the web in shear. The amount of this error is not known, but it seems that it cannot be more than the total load carried by a beam like 4AG1 and 4AG2, and it probably is somewhat less. In these beams the web was entirely absent and the loads were carried by frame action alone. To carry load by the frame action of the flanges and end pilasters relatively large deflection is necessary. This is indicated by the large amount of deflection at maximum load given in the table for beams 4AG1 and 4AG2. When the web is present, deflection is prevented to a certain extent by the shearing stresses set up in the web, and the load carried by frame action must be correspondingly less. In later tests, measurements will be made in an effort to determine how much of the shear passes through the web.

The observed stresses in the reinforcement at maximum load, as given in the table, are in most cases greater than were indicated by the strain-gage readings. Usually, after the maximum load was reached the yielding of the beam was so rapid that the load fell off and the stresses were relieved. This is illustrated in Fig. 4, which indicates that the stress in the longitudinal reinforcement increased progressively up to the load just before the maximum but that it had decreased at the maximum load. For such cases the load-stress curves were produced to obtain the most probable stress value for the maximum load.

Up to the time of this report, about 85 beams in all had been tested. This investigation was designed to cover the conditions met in ship practice, and, besides the results given in this article, involves beams with longitudinal reinforcement in the web and beams with diagonal compression reinforcement. Expanded metal also was used as web reinforcement in certain of the test beams. Although certain important conclusions are suggested by the test results already obtained it is not the purpose of this article to discuss generally the significance of the results. The investigation is incomplete, and later results may cause important modifications of present indications. One fact which stands out, however, is that with beams of this type larger shearing stresses could be used safely than those which are recognized in standard building regulations. In order to establish the safety of increasing the allowable shearing stresses in general practice, the investigation needs to be extended along lines which in this series of tests have scarcely been touched. This extension should

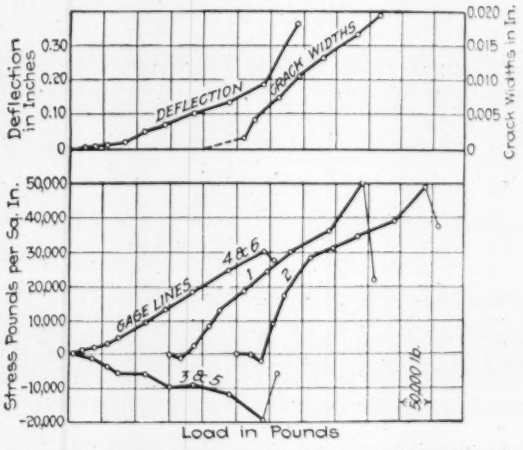

FIG. 4. VARIATION IN DEFLECTION AND CRACK WIDTHS WITH LOAD AND STRESS

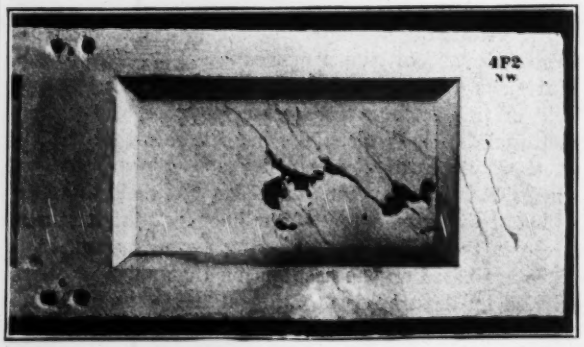

FIG. 3. SHEAR CRACKS IN BEAM UNDER MAXIMUM LOAD

determine the effect of (a) variation in spacing of stirrups; (b) variation in ratio of depth to span of beam; (c) variation in strength of concrete used; (d) variation in depth of embedment of stirrups for anchorage; (e) variation in amount of longitudinal reinforcement.

Considering these results in relation to general practice in reinforced concrete, it does not seem unreasonable to expect that the establishment of shearing strengths of reinforced-concrete beams for the variety of conditions enumerated will mark a distinct step in advance in the application of concrete to buildings and bridges where now the limitations in shearing strength either prevent its use entirely or seriously handicap economical design.

A continuation of these investigations by the Emergency Fleet Corporation cannot be made, but plans are under way for a larger investigation by the Bureau of Standards, to give information on the subjects enumerated in the preceding paragraph. Such an investigation adequately conducted will be expensive. While funds are not now in sight for the carrying out of the entire program, efforts are being made to secure the financial support that is necessary to do justice to this important subject.

The Angle as a Beam

Section Moduli for Angles of Various Sizes in Various Positions Tabulated for Comparison

By R. Fleming
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Values for the section modulus of various angles in the positions shown by Figs. 1, 2, 3 and 4 are shown in the accompanying Table I.

The common method of calculating the strength of an angle beam with load normal to one of the legs is by substituting the values of I and c, taken from the manufacturers' handbooks, in the flexure formula, $M = fs = f(I/c)$ and solving for f. This, however, assumes that the neutral axis is parallel to one of the legs and that the angle can deflect only in a vertical direction. The Carnegie "Pocket Companion" and other handbooks give tables of allowable uniform load on angles as beams. In all cases it is stated that the tables are based on the neutral axis parallel to one of the legs. From the columns headed Fig. 1 and Fig. 2 in Table I it will be noted that the section moduli and therefore the allowable normal loads for angles used as beams free to bend in any direction are about 75% of those for angles stayed against lateral movement.

TABLE I. VALUES OF SECTION MODULUS FOR POSITIONS OF ANGLE SHOWN IN FIGS. 1-4

Angle, Inches	Fig. 1	Fig. 2	Fig. 3	Fig. 4
2 x2 x⅛	0.25	0.18	0.26	0.17
2½x2½x⅜	0.39	0.31	0.42	0.28
3 x2½x⅜	0.57	0.44	0.65	0.39
3½x2½x¼	0.75	0.56	0.89	0.47
4 x3 x⅜	1.24	0.93	1.43	0.79
5 x3½x⅜	1.93	1.48	2.30	1.25
6 x4 x½	3.32	2.50	3.98	2.02

The most frequent use of angles as beams is for purlins on sloping roofs. Textbooks do not mention that purlins set as shown in Fig. 3 are stronger than when set as in Fig. 4. It is evidently taken for granted that a designer should know this without being specifically told by a textbook. Yet, either through ignorance or to suit local conditions, purlins are sometimes set as shown in Fig. 4. They are so shown in a number of handbooks. By consulting Table I it may be seen that the purlins of Fig. 4 have but 51% to 67% of the strength of the purlins of Fig. 3. Table II is given for reference. The

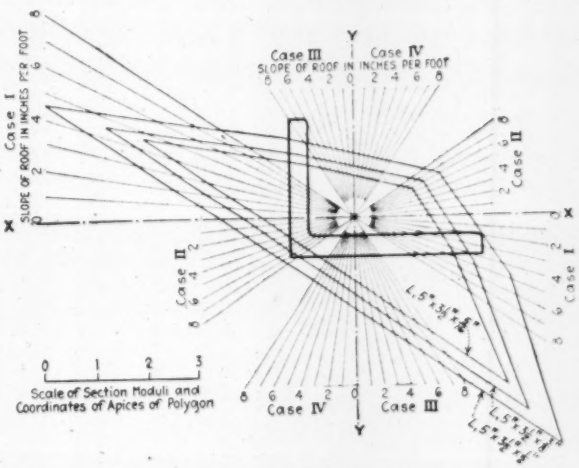


FIG. 5. DETERMINATION OF SECTION MODULI FOR THREE ANGLES BY S-POLYGONS

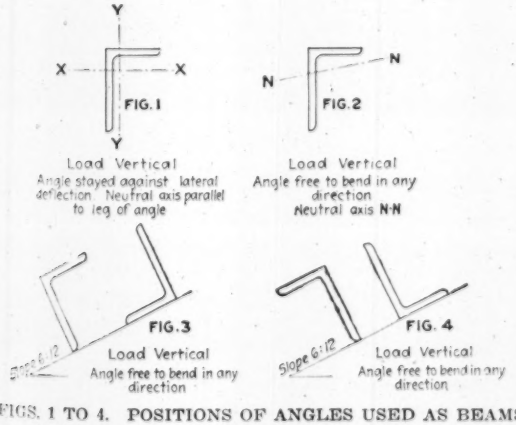


FIG. 1
Load Vertical
Angle stayed against lateral deflection. Neutral axis parallel to leg of angle
FIG. 2
Load Vertical
Angle free to bend in any direction
Neutral axis N-N
FIG. 3
Load Vertical
Angle free to bend in any direction
FIG. 4
Load Vertical
Angle free to bend in any direction

FIGS. 1 TO 4. POSITIONS OF ANGLES USED AS BEAMS

TABLE II. SECTION MODULI OF ANGLE PURLINS AT RIGHT ANGLES TO ROOFS; LOADING VERTICAL

Angle, In.	Slope of Roof in Inches per Foot: 0	1	2	3	4	5	6	7	8
2 x2 x⅛	0.18	0.19	0.20	0.21	0.22	0.24	0.26	0.29	0.31
2 x2 x¼	0.27	0.28	0.29	0.31	0.33	0.35	0.37	0.40	0.42
2½x2 x⅛	0.30	0.31	0.33	0.35	0.38	0.41	0.44	0.46	0.49
2½x2 x¼	0.40	0.42	0.45	0.48	0.52	0.57	0.61	0.65	0.69
2½x2½x⅜	0.31	0.32	0.33	0.35	0.37	0.39	0.42	0.45	0.48
2½x2½x¼	0.42	0.44	0.46	0.49	0.52	0.55	0.60	0.64	0.68
3 x2½x¼	0.44	0.46	0.49	0.52	0.56	0.60	0.65	0.69	0.74
3 x2½x½	0.64	0.67	0.71	0.76	0.82	0.89	0.95	1.00	1.06
3½x2½x¼	0.56	0.59	0.64	0.70	0.76	0.83	0.89	0.96	0.84
3½x2½x½	0.84	0.89	0.96	1.04	1.14	1.22	1.29	1.37	1.19
4 x3 x½	0.75	0.80	0.86	0.93	1.02	1.11	1.18	1.26	1.27
4 x3 x¾	1.11	1.18	1.26	1.35	1.47	1.58	1.70	1.81	1.76
5 x3½x⅝	1.48	1.55	1.66	1.80	1.96	2.12	2.30	2.39	2.06
5 x3½x¾	1.76	1.86	1.99	2.15	2.34	2.52	2.71	2.80	2.42
6 x4 x¾	2.50	2.66	2.87	3.10	3.41	3.70	4.00	3.64	3.17
6 x4 x⅞	3.30	3.52	3.79	4.10	4.52	4.84	5.18	4.65	4.09

angles are assumed to be set as in Fig. 3. It may be mentioned that the section moduli in both tables, except those for Fig. 1, have been scaled from carefully drawn "S-polygons." Three of these polygons are shown in Fig. 5. The coördinates of the apices are taken from the late Professor Waterbury's "Stresses in Structural Steel Angles." Case I is for the angle turned as in Fig. 3, Case II as in Fig. 4, and Cases III and IV as in Figs. 3 and 4, with the short leg at right angles to the rafter. The *shorter* distance from the origin of coördinates to the perimeter of the polygon should be used as the section modulus for each slope.

Shipyard on New Orleans Canal For Building "Unsinkables"

Range of Mississippi River Stage Determined Location—Work Started When Navigable Water Was Five Miles Away—Fabricating Shop a Group of 35-Foot Working Bays—Tractors Haul Material to Berths

WHEN the Foundation Co. drove the first piles for its New Orleans shipyard in the spring of 1917 the nearest navigable water was five miles away. Since then, dredges working on the new industrial canal for the City of New Orleans have cut a channel to the shipyard site, and before the first vessel is ready to start on her trial trip the canal will be open to deep water.

The location of a yard at New Orleans involved conditions differing widely from those in other parts of the country. The Mississippi River has a range of over 20 ft. in elevation making it unsafe to cut through the levee for launching ways. Lake Pontchartrain, on the other hand, has a depth of only 9 ft., which is, of course, insufficient for large-sized vessels. Advantage was therefore taken of the ship canal, from the river to the lake, which the city is now building for industrial development. A lock near the river bank will maintain the canal at the level of Lake Pontchartrain. The ordinary variation in the lake is only 2 or 3 ft., due to the small tide in the Gulf of Mexico, though after exceptionally heavy storms there may be a variation of as much as 8 ft. An excellent shipyard site is also provided beside the wide turning basin at about mid-length of the canal.

The property developed by the Foundation Co. is on the west bank of the basin, adjoining a built-up section of New Orleans. As electric cars provide quick access to the center of the city, no housing problem for labor is involved. The yard is served by the Public Belt R.R. and is supplied with water and electricity from the city systems.

The size of the turning basin will permit end launching of the hulls, which has advantages over side launch-

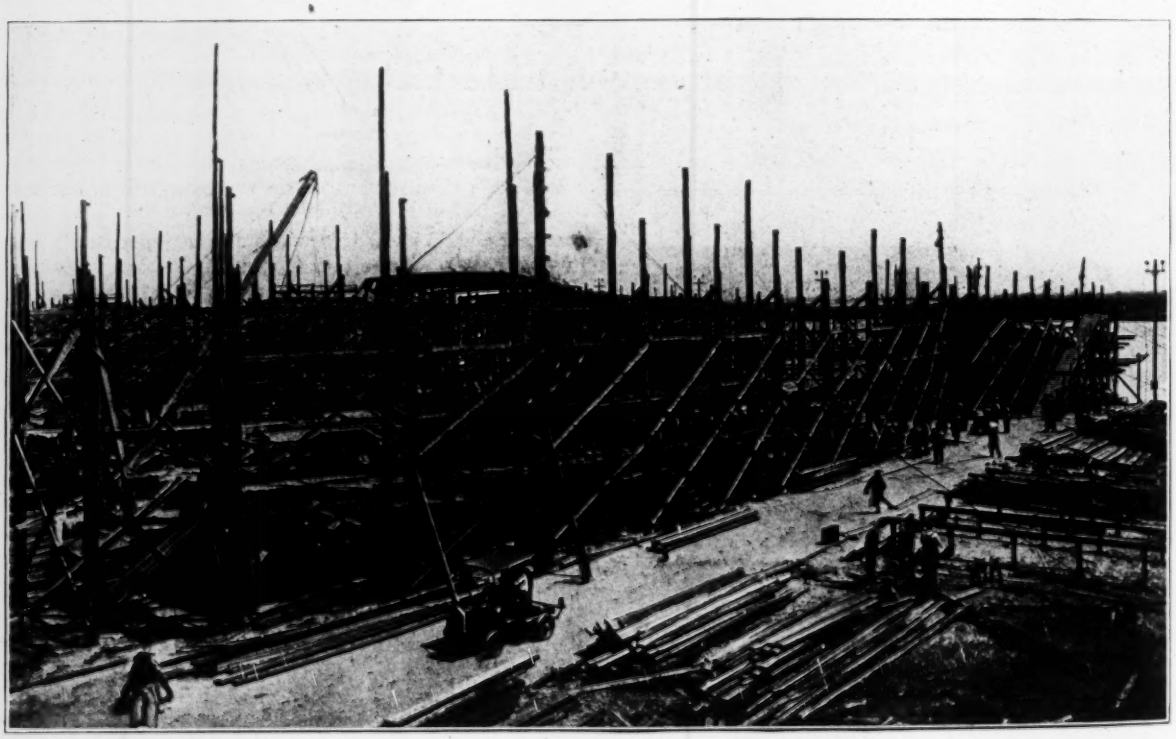


FIG. 1. SHIPYARD BEFORE COMPLETION OF DERRICK TOWERS; A FLEET OF TRACTORS LIKE THAT IN FOREGROUND DOES MOST OF YARD HAULAGE

ing in economy of water front and ease in handling material. There is ample space also, for laying up vessels to be fitted out.

Plate Yard Served by Locomotive Cranes.—Raw steel is brought into the yard (see the plan, Fig. 2) on a standard-gage railroad track, and is distributed in the storage yard so that plates are near one end of the plate-and-angle shop, and angles and shapes near the opposite end. Steel is unloaded from the cars and stored by locomotive cranes. These cranes also load the material on small cars and push them into the ends of the plate-and-angle shop, where the material is handled by an overhead traveling crane.

The plate-and-angle shop is located just far enough back of the building ways to leave ample space for the storage of fabricated material before erection in the hulls. It is a timber-frame building (Fig. 4) 206 x 350 ft., with post spacing 24 ft. by 35 ft. The roof is of sawtooth construction, with provision for ample lighting of the interior. The sides are not covered below the bottom chords of the trusses, except around the north end, where the machine-shop equipment is located.

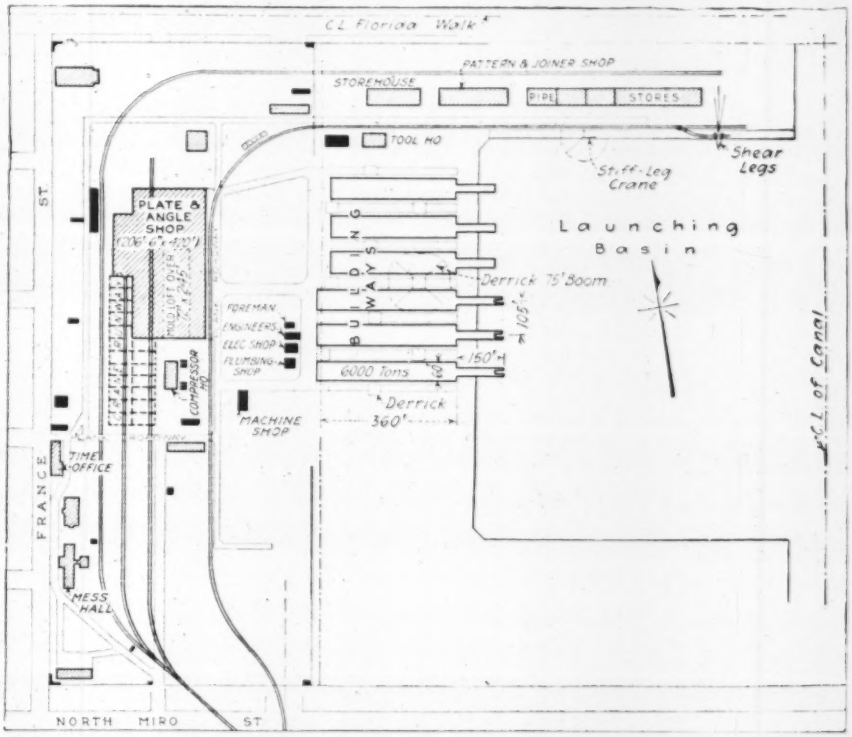


FIG. 2. PLAN OF YARD—FIVE END-LAUNCHING WAYS; LARGE STORAGE SPACE BETWEEN SHOP AND WAYS

Fabricating-Shop Layout—A craneway runs along the entire length of the west side of the shop and extends beyond it 315 ft. over the steel-storage yard. It carries a five-ton electric traveling crane of 60-ft. span. The crane handles raw stock coming into the building from either end, loads material on working skids from cars, or places it so that it can be picked up by one of the two-ton hand cranes which extend along the nine small transverse bays along the east side of the shop.

In the 60-ft. bay of the shop, where raw steel is received, are the layout skids for plates, angles and shapes. The furnaces are in a leanto at one side. Each cross-bay, Fig. 3, is laid out to handle a separate class of work, and contains the tools necessary for the operations to be performed.

The northerly bay, between columns 1 and 2, is inclosed, and forms the machine shop. South of it, the bay between columns 2 and 3 is devoted to forging; it contains the hand forges, a small annealing furnace, and hammers. The next three bays, between columns 3 and 6, are for working angles and frame stock, and contain the angle and beam shears, punches and benders. The remaining five bays contain the plate shop equipment. Its principal punching units are five 30-ft. Lysholm plate tables, operated in conjunction with 36-in. and 60-in. vertical punches. From these punch tables, plates are worked ahead to the radial countersinking and drilling machines and to the 30-ft. plate bending rolls at the east side of the building, between columns 6 and 7.

Tractor Haulage System—The yard was originally laid out with railroad tracks running to the shipways. Locomotive cranes were to be provided, so that cars could be unloaded either at the storage piles or at the ways. This method was abandoned later, however, and a tractor system substituted.

Five small gasoline tractors, manufactured by the S. K. Prescott Co., Seattle, Wash., provide the motive power. These tractors, one of which can be seen in the view, Fig. 1, are equipped with a 22-hp. four-cylinder Ford motor; they weigh 2800 lb., and can travel from three to 20 miles an hour. A number of four-wheeled trailers are also provided.

A system of plank roadways is built through the plate-and-angle shop and around the yard, so that tractors and trailers can carry materials to any point where they are needed. Light pieces are loaded and unloaded by hand; heavy pieces are loaded at the shop by the two-ton overhead cranes, and are unloaded at the storage piles by small stiffleg derricks conveniently located. When fabricated work is taken directly to the ways, the trailers are unloaded by the tower derricks.

Tower Derricks—Material is handled at the building slips by tower derricks. These consist of timber towers 32 ft. square, ranging from 35 to 48 ft. high, the 48-ft. towers being near the head of the ways. The yard plan, Fig. 2, indicates their position with respect to the

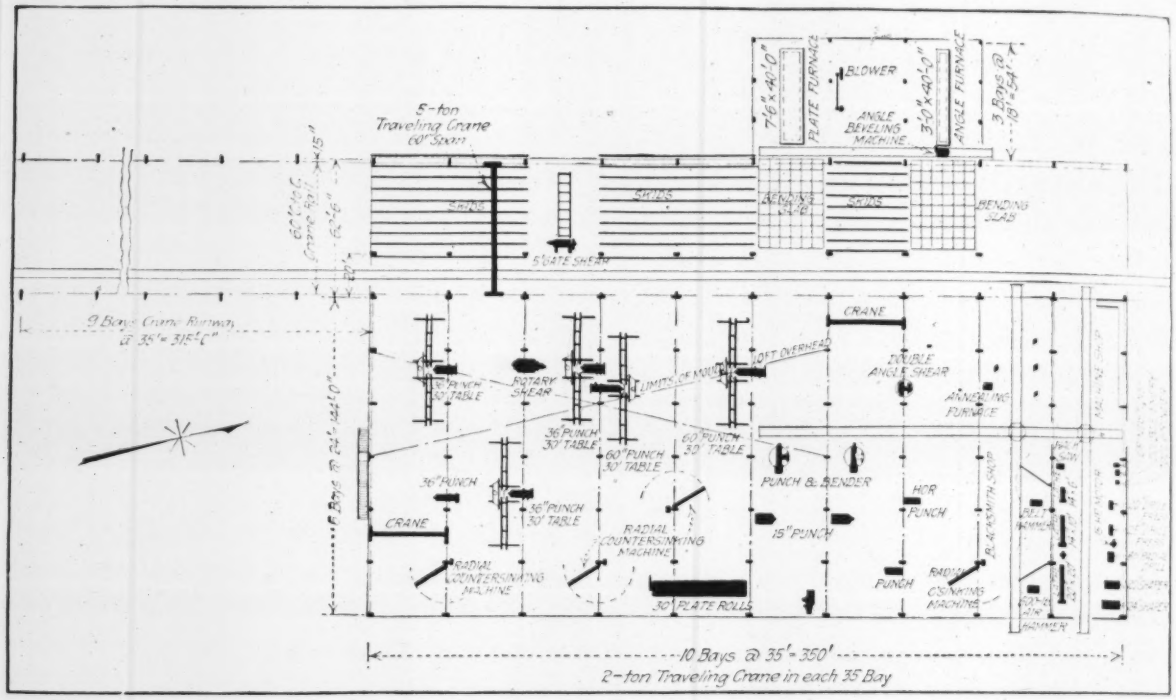


FIG. 3. MATERIAL ENTERS WIDE LAYOUT BAY OF SHOP AND MOVES THENCE CROSSWISE ALONG ANY OF NINE FABRICATING AISLES

slips. Each tower carries a Terry standard steel derrick with 75-ft. boom, having a capacity of five tons at 75 ft. or 15 tons at 45 ft. The derrick is not fixed on the tower, but is set on a turntable. This device allows the mast to be swung to four different positions, so that the derrick can cover an area nearly 100 ft. in radius, and yet has the advantages of the speed and lightness of a shorter boom.

Wharves along the side of the launching basin serve in fitting out the hulls. A 10-ton derrick is set up on one of these wharves, and a 65-ton shear leg on the other wharf. The buildings used in fitting out the vessels, such as the joiner shop, the sheet-metal shop, the electrical shop, the pipe shop, and the storehouse for fittings, are all located conveniently to the wharves. Standard-gage railroad tracks and planked roadways for motor trucks are provided for the delivery of materials. From these shops, fabricated materials will be delivered to the wharves by motor tractors.

Timber Shear-Leg Derrick—The shears have a lifting capacity of 65 tons, sufficient to permit handling a Scotch boiler of the size to be used in these vessels, from the flat-car to the hull. A canvass of the derrick manufacturers developed the fact that none of them had standard designs for such a derrick; in fact, the few derricks of this type built have been largely designed and assembled by the owners. The engineers of the Foundation Co. therefore designed their own shears. Economy and ease of obtaining parts in the open market received first consideration.

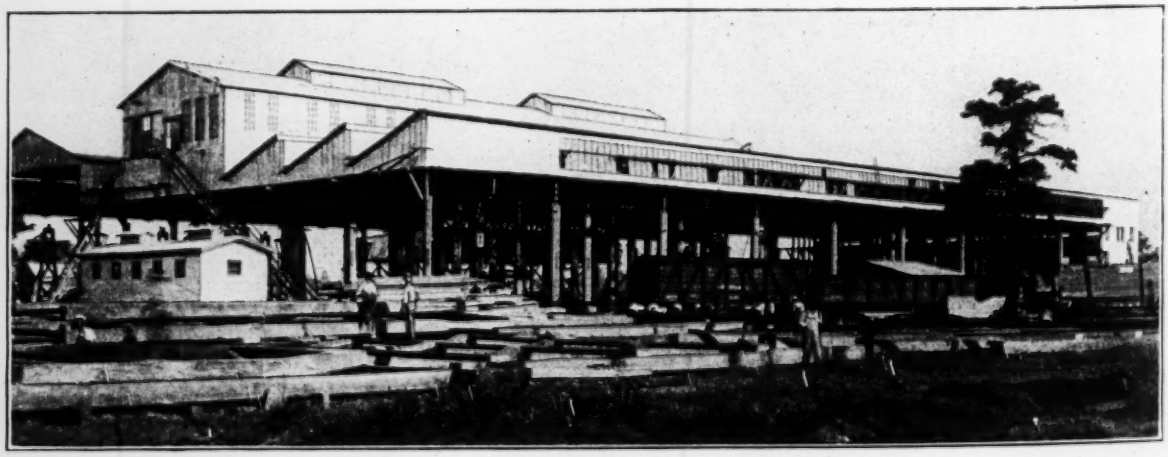


FIG. 4. TIMBER-FRAME FABRICATING SHOP WITH OPEN SIDES

The machine comprises a vertical A-frame or mast 99 ft. high, and a tilting A-frame or boom 99 ft. long, each leg of which was built of four pieces of 12 x 12-in. long-leaf yellow pine, bolted together and spliced with steel plates, as shown in Fig. 5. Instead of having the usual backstay of timber or steel, the mast is guyed fore and aft by means of 1¾-in. plow-steel cable, the forward guys being attached to the wharf construction at the water's edge, while the back guys are

Motor-generator sets to furnish current for crane and derrick service are located in the compressor house, situated near one end of the plate-and-angle shop, whence it can furnish air to shop and ways with minimum length of distributing lines. Motor-driven air compressors of 4500 cu.ft. per minute capacity are installed in the compressor house.

At present there are three building ways, but space has been left and the whole layout arranged so that five

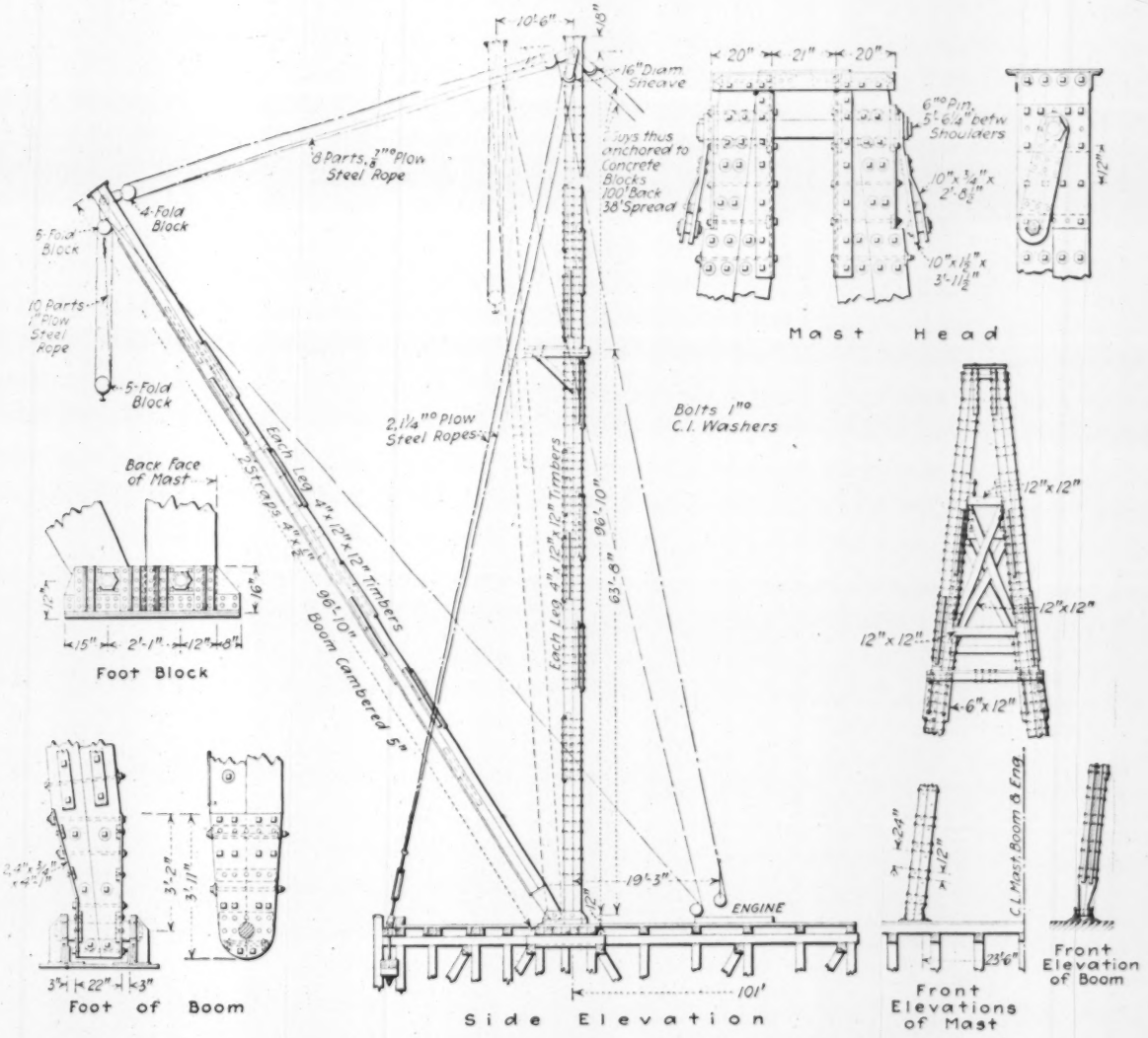


FIG. 5. SHEAR LEGS FOR LOADS UP TO 65 TONS; MAST GUYED BY ROPES

carried 100 ft. to the rear of the mast and anchored to concrete blocks built on pile foundations.

The mast and boom heads and foot blocks were built of standard structural shapes. The whole framed structure was so designed that the rough timber and structural steel could be delivered to the shipyard, and be fabricated and erected; the exception to this being the pins through the mast and boom heads and foot blocks, which were purchased already fabricated. All blocks, shackles, cables and cable fittings were stock material purchased in the open market. The hoisting engine is a double-drum electrically driven machine having the capacity to hoist 14,000 lb. 100 ft. per minute.

additional ways can be installed. There is also room for the construction of a complete repair yard with dry-dock facilities.

The Foundation Co. is building at this yard for the French Government five 4250-ton dead-weight capacity steel cargo steamers of the "Le Parmentier" "unsinkable" type.

Unlike previous designs, which involve modifications of a standard cargo steamer, the "Le Parmentier" design makes a radical departure from usual forms of ship construction, as will be noted in the sketch, Fig. 6. In external appearance the vessel resembles whaleback steamers, but its cross-section is in the form of two circles side

by side, connected above and below by curved segments.

The hull consists of two parallel cylinders 20 ft. in diameter, arranged horizontally side by side and connected by transverse water-tight bottom and deck. The cylindrical form not only gives maximum strength, but also provides double inner longitudinal walls to localize flooding of the hull if the outer skin is ruptured. The

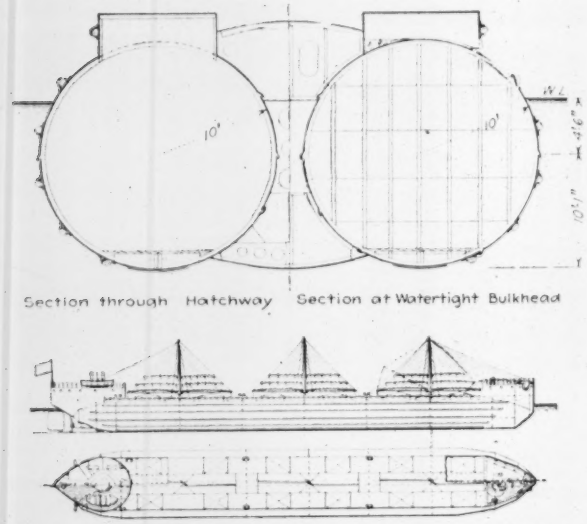


FIG. 6. FRENCH "UNSINKABLE" SHIP, "LE PARMENTIER" TYPE BUILDING AT NEW ORLEANS

entire hull is stiffened and receives further protection from flooding by seven transverse water-tight bulkheads, which divide the hull into 24 separate compartments.

The steamers now under construction are 328 ft. 4 in. long over all; 46 ft. 5 in. in beam, and 16 ft. 1½ in. in maximum draft. The propelling machinery will consist of twin triple-expansion 700 hp. engines, designed to give the vessel a speed of approximately eight knots, loaded. Steam will be supplied by Scotch boilers fired with oil fuel.

As one complete power plant is installed in each half of the hull, the vessel can be brought into port even though one side has been completely flooded.

According to the present schedule, the first hull will be launched soon, and will be completely equipped ready for service in the latter part of the summer.

The New Orleans yard is the largest of the three steel shipbuilding plants controlled by the Foundation Co.; the other two being at Savannah, Ga., and Port Huron, Mich.

The Foundation Co.'s experience in shipbuilding began in July, 1917, when it laid the keel of a 3500-ton Ferris-type ship for the Emergency Fleet Corporation. Since then it has completed 40 wooden auxiliary schooners and 15 cargo-steamer hulls, with a total deadweight capacity of 169,000 tons—a greater production than is credited to any other wooden shipbuilding organization in the country.

Franklin Remington is president and John W. Doty is vice-president of the company. Construction is under the supervision of C. A. D. Bayley and Bayly Hipkins, vice-presidents in charge of shipbuilding on the Atlantic and Pacific Coasts, respectively. H. J. Deutschbein is general manager and Cox & Stevens are the consulting naval architects of the company.

Motor Truck Costs Much Higher Than Generally Assumed

Data Collected by Motor Truck Association Show High Average Operation Expense — New Cost System To Be Recommended

OPERATION cost for motor trucks was the subject discussed at a recent informal meeting of the Motor Truck Association of America, the purpose being to start investigation and determine a proper cost-accounting system. It was asserted that many published costs are much too low and work injury to contractors and haulage companies basing charges upon them, and putting the stigma of overcharge upon those who place their charges high enough to meet actual conditions. As a basis for the investigation, the cost for a five-ton gasoline truck shown in detail in Table I was submitted by one of the largest operators of trucks in the East.

TABLE I. COST PER DAY OPERATED FOR FIVE-TON GASOLINE UNIT BASED ON 50 MILES PER DAY PER TRUCK AND 300 DAYS PER YEAR

	Amount	Totals
Direct Charges		
Driver	$5 00	
Tires, based on present cost of tires (guaranteed basis)	3 00	
Oil, grease, kerosene, graphite, etc	50	
Gasoline, 3½ miles to gallon = 14 gallons @ 25c. per gallon (average)	3 50	$12 00
Indirect and Overhead Charges		
Depreciation, 20% on $6,000 investment	4 00	
Interest, 6% on $6,000 investment	1 20	
Insurance, averaged at $450 per year	1 50	
Garage, rental, upkeep, etc., $300 per year per car	1 00	
Maintenance, minor repairs, supplies, tire chains, tools, lamps, springs, spark plugs, equipment, etc. (estimated)	1 00	
Overhaul, complete, pro-rated, $600 yearly	2 00	
License fee	20	
Body upkeep, repairs and painting	30	11 20
Supervision, based on 10% of above costs		2 32
Lost time—time lost in repairs, no work, weather, or other causes 20% of total less gas, tires and oil, etc., $7		3 70
Total cost per day operated		$29 22

with the suggestion that it be sent out to all truck operators, requesting them to criticise it and submit their own costs for the information of the association.

The table is based upon actual experience; it is assumed that the truck makes 50 miles per day and works 300 days per year. The direct charges are accumulating only while the truck is under operation, while the indirect are those which are accumulating whether the truck runs or not. Supervision includes all office expenses, stationery, printing, advertising, office help, telephone charges, outside men, etc. The cost of mechanical garage equipment, power, spare parts, etc., with interest on the same, and depreciation, is included in the amount charged to maintenance and overhaul.

Average operating conditions as to load were used in compiling this table. Up to the present time these have equaled a full load one way or, for a 50-mile day, transportation of 125 ton-miles at about 24c. per ton-mile. The costs are actual, no profit being included to cover risks, etc.

Table II gives the costs as sent in by six trucking

companies in answer to the inquiry. The averages shown in the last two columns include the figures in Table I.

In considering the returns, it will be noted that many of the differences are in such elusive items as overhead, supervision, and lost time. The averages in the last two columns were obtained by adding the amounts together and dividing by the number of reports on that item. The average total cost per day,

TABLE II. ANSWERS RECEIVED ON THE INQUIRY SENT OUT, USING THE SAME ITEMS AND BASIS FOR FIGURES

	A	B	C	D	E	F	Average	
	Amt.	Amt.	Amt.	Amt.	Amt.	Amt.	Amt.	Total
Direct Charges								
Driver	$5 00	$5 20	$5 00	$5 00	$5 17	$5 50	$5 13	
Tires	3 00	3 75	2 00	2 00	2 00	3 00	2 68	
Oil, etc	30		30	50	25	25	35	
Gasolene	3 00	4 00	3 50	4 65	2 08	3 75	3 50	
								$11.66
Indirect Charges								
Depreciation	$3 50	$4 19	$3 60	$3 40	$3 67	$4 00	$3 77	
Interest on Investment	1 20	1 26	1 08	1 22	1 10	1 00	1 15	
Insurance	1 50	2 54	1 26	2 10	86	50	1 47	
Garage	1 00	1 20	1 00	1 00	89	1 00	1 01	
Maintenance	50		50		1 00		75	
Overhaul	1 33	2 75	1 80	1 60	2 00	3 00	2 07	
License	17	27	20		20	20	20	
Body upkeep	25		30	10	40		27	
								10 69
Supervision	50	2 93	2 05	1 90			1 90	1 90
Lost Time	2 20		1 67	3 40	2 50	1 97	2 57	2 57
Total	$23 45	$28 09	$24 26	$27 07	$22 12	$24 17		$26 82

while somewhat less than the suggestion sent out, in the main agrees very well. In sending out the suggestion, it was not thought that there would be agreement within several dollars, but it was believed that a much higher cost would be shown than is generally supposed.

The figures as given apply particularly to operation of trucks in large fleets, such as those employed by the interurban haulage companies. They were furnished by companies operating out of New York City.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Kansas Engineering Society Advocates Standardized Fees

At the recent annual meeting of the Kansas Engineering Society great interest and activity among the members were manifest in connection with a more closely organized movement to improve the remuneration for engineering services. A resolution was passed providing for an appeal to the four great national societies and the Engineering Council, asking that they act in unity by (1) providing a practicable plan for the registration and proper classification, according to character of services, of all professional engineers and their assistants; (2) arranging a standard nomenclature to designate the various capacities in which engineers and their assistants serve; (3) adopting, after careful study, a scale of fees and of salaries for the young men of the profession, in such forms that it can be used by all local organizations of engineers throughout the nation in their efforts to secure a fair comparative compensation in accordance with the value of services rendered, and (4) providing a standing committee to coöperate with all local organizations of engineers in matters pertaining purely t compensation.

The Kansas Engineering Society, according to the resolution, pledges its allegiance and support to the national societies in the measures they may develop to supply these urgent needs for placing the profession of engineering on a proper plane of industrial equity.

Straw Ballots to Arouse Civic Interest

One of the methods used at the Feb. 7 meeting of the Chicago Chapter of the American Association of Engineers to awaken in its members a sense of their duties as citizens was a straw ballot on the five candidates seeking nomination in the mayoralty primaries. Five additional "yes-and-no" questions were answered as follows: Replies to the number of 121 favored political action along practical lines to further the objects for which the association was formed. One was against it. A unanimous vote was polled on the question: "Are you willing to pledge your support to the candidate for mayor of Chicago and for alderman in your ward who by his record and in his public utterances shows himself most favorable to the objects sought by our organization?" Of 115, 20 indicated that they were not registered voters, but 13 of these said they would try to register. Party affiliations indicated 80 Republicans, 26 Democrats, 3 Socialists and 9 independents.

Northwest Association Considers Technical Publicity

At its bimonthly meeting Jan. 28 the Northwest Association of Members of the American Society of Civil Engineers heard W. W. DeBerard, Western editor of *Engineering News-Record* in an address on "Technical Publicity," illustrated by lantern slides. In the discussion which followed C. W. Tubley, mechanical engineer, stated that until hearing the address he had never understood what could be accomplished by publicity, and that he was a convert to the idea. A leading consulting civil engineer, L. P. Wolff, proposed that the American Society should set aside $100,000 annually for publicity work, $50,000 to be paid to five writers to furnish engineering articles for the daily and Sunday papers, and the balance for expenses of inaugurating and maintaining the work. Another engineer spoke of the attitude of newspaper editors, saying that it was impossible to get reporters to write engineering articles in an intelligent manner and that it was also impossible to get engineers to do so from the newspaper man's point of view.

Minnesota Senator Asks Engineers' Help in Framing Drainage Bill

Frank statements were made by a Minnesota state senator who appeared before the St. Paul Engineers' Club, Jan. 24, to the effect that a proposed drainage bill drawn by an attorney had so many faults it should have been drawn by engineers in the first place. As

it was, he asked their assistance in amending the bill. This is being undertaken by a process of careful study and discussion, first at the club's regular meetings. The conclusions of these deliberations were referred to the Minnesota Surveyors and Engineers' Society meeting, Feb. 12-14. If unified action is secured, the whole matter will be put in the hands of the Minnesota Joint Engineering Board for presentation to the legislature. Thus all classes of engineers will have a chance to know how it may affect them.

This method of putting the same proposed legislation through these different organizations will tend to popularize the bill and arouse interest in it by a large number of engineers; also, the bill finally will go to the legislature in a form commanding unanimity of engineering opinion and from a body representing practically all the organized engineers of the state. It is an example of democratic society service to the public worthy of emulation elsewhere.

Duluth Engineers Recognize Public Service Responsibilities

Practically all organizations of engineers have based their constitutions on the idea of service to engineers and "the advancement of engineering knowledge and practice and the maintenance of a high professional standing among members." It is refreshing, therefore, to read the following from the constitution of the recently formed Duluth Engineers' Club. It indicates the awakening of the engineers in the Northwest to their civic responsibilities and to their duty of service to those members of the community outside of the profession:

"The name of this corporation shall be the Duluth Engineers' Club; its general purpose is to create an instrument by which united action can be obtained by the members of the engineering profession in Duluth and vicinity; to serve the community, state and nation better than in the past; to raise the standards of the profession and the ideals of the individual, to make the profession more worthy of consideration by the community; to awaken among engineers an interest in all civic matters in general, and particularly in regard to matters for which the engineer, because of his training, should feel a peculiar civic responsibility; to make the community aware of the service the engineering profession is prepared to render; to add to the scientific knowledge relating to engineering; to increase social intercourse between members of the profession, and in general for uplift of the community, the profession and the individual."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Deterioration of Burlap in Waterproofing

Sir—The writer read with considerable interest the letter in your issue of Feb. 6, 1919, from A. H. Rhett, commenting on an article by H. T. Welty, engineer of structures of the New York Central R.R., published in your issue of Dec. 12, 1918, p. 1081. The instance given of the successful use of a single layer of untreated burlap is interesting, but "one swallow does not make a summer." I do not think that Mr. Rhett carried the chemical investigation of the destruction of burlap in a waterproofing course sufficiently far to reach the correct conclusion.

It is undeniably true that there is a marked percentage of sulphur in coal-tar pitch and a lesser percentage in asphalt, and it is also conceivable that this sulphur reacted, to some extent, against burlap. However, the presence of a sulphur content in asphalt or coal-tar pitch is not the reason why burlap should be excluded from a waterproofing system, nor is it the reason why a cotton fabric is considered by engineers, generally, as the preferable membrane.

Reference to any standard work on industrial organic chemistry will show that burlap is chemically a combination of lignin and cellulose chemicals; that it is the most perishable of all vegetable fibers; that even the small amount of moisture in the air will cause it to deteriorate very rapidly, and, finally, that this rate of deterioration is greatly increased where the moisture carries alkali. Inasmuch as the waterproofing is to be placed on an alkali surface and is to be covered over with a body of alkali materials, all water which reaches the waterproofing course must contain alkali, and if a pinhole is left in the top swabbing of the waterproofing agent, water will reach the burlap and, as the latter is intensely hygroscopic, will be drawn indefinitely through the blanket, rotting large sections.

There appears to be also a serious misunderstanding as to the object in saturating a waterproofing membrane. It is not, as Mr. Rhett asserts, for the purpose of securing a thorough bond between the fabric and the compound. Inasmuch as burlap with its wide-open mesh will permit the ready passage of compound through the fabric and the consequent sealing of one layer with another through the open mesh, it is possible to secure a good bond in the blanket as a whole and consequent compactness. The object of saturation is, entirely, preservation; so that if, as is very apt to happen in practice, an imperfection is left in the final swabbing coat whereby water can reach the membrane directly, the membrane will be protected from rot or from the lateral translation of water by capillary attraction.

To refer back to the most frequent cause of the deterioration of burlap in a waterproofing blanket, we find that the burlap fiber is naturally extremely brittle. In its manufacture into yarn, to be subsequently woven into fabric, this fiber is treated by long immersion in a combination of oils, consisting of a small percentage of sperm oil, the balance being the cheaper vegetable oils indigenous to the Far East. When the burlap fiber, through this treatment, has become thoroughly impregnated with these oils, the oils are squeezed out and the fiber is turned into yarn and subsequently into fabric. These oils are a solvent for both coal-tar pitch and asphalt. Moreover, they are volatile. When the

hot compounds are applied to the burlap, part of the oil is volatilized and what remains is gradually, through the processes of time, absorbed by the waterproofing compound. The burlap is thus reduced to its original condition of extreme weakness and great fragility.

For these reasons the writer is convinced that Mr. Welty is absolutely correct both theoretically and practically in advocating the use of a cotton fabric, as against one made of jute. J. B. W. GARDINER.

No. 18 E. 41 St., New York City.

How Building Is Promoted in Huntington

Sir—In connection with the articles you have been publishing on methods of encouraging building, I would like to outline the scheme, which we call the "Huntington, Ind., Plan," that has proved successful in this city. As a testimonial to the workings of the plan, I might say that statistics showed that in Huntington, a city of 20,000 population, there were more new houses built last year, in proportion to the population, than in any other city in Indiana.

One year ago several of our progressive builders, supply dealers and lumbermen organized what we called the Huntington Community Development Club. The organization was made up of the lumber dealers, building-supply dealers, hardware merchants, plumbers, electrical contractors, sheet-metal contractors, furnace dealers, furniture dealers; in fact, any class of people in our community who were interested in the sale of material entering into the building of a modern home. We elected a president, secretary and treasurer and an advertising committee. Our plan was to have each member subscribe a small amount toward a fund to be used for educating our people to the fact that they should build homes now. We used full-page space in our two daily papers, and the result, we are confident, was that we encouraged a great many people to build homes, which were badly needed in our city at that time and are still just as badly needed.

The plan worked out so well and we had so good a reputation last year that we have reorganized our committee again this year and have added a number of other firms to our list, including real estate dealers and building contractors, such as carpenters, masons and cement contractors. In raising our fund we have no amount larger than $25 and nothing less than $10. This gives us a fund of between $500 and $600, which we will invest in full-page space in our two daily papers. You can readily see that this is a very small expense to any one of the firms interested, but on the whole it will amount to fine publicity in increasing the interest in building conditions in our own locality.

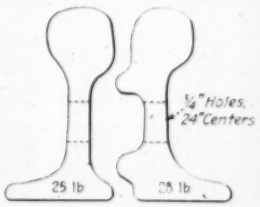
The advertisements refer simply to general building conditions, and do not advertise any one particular commodity. We had some mighty fine "copy" in our last year's campaign, and I think we could furnish anyone who would be interested with duplicates of our "copy" if any would care to adopt the same plan. Furthermore, if any of your readers wish to go into this matter and adopt the Huntington plan and will correspond with me, I shall be very glad to put them on a mailing list and send them copies of our local papers as our advertisements appear.

I am confident that if all of the smaller cities would adopt this plan, which would not be a very expensive one owing to the small rate for advertising space in cities of this size, we would create a great deal of interest throughout the United States and encourage a great deal more building than would be possible if the attention of the people were not called to it through a sane and careful advertising campaign.

J. M. TRIGGS,
Huntington, Ind. The Majestic Company.

Finds Peculiar Old Railroad Rails

Sir—I am inclosing a drawing of a section of compound rail found in the vicinity of Camp Sherman, Ohio. In making a topographical survey of the surrounding country I found the rail shown in the right-hand sketch. It was 16 ft. long, not very badly corroded, but had the heaviest fish tails on the outside of the head I ever saw on a rail. No one recognized it as part of a rail, and I did not think of it as such until I found, on another farm, the rail represented by the left-hand sketch. This rail was also 16 ft. long. Both rails have evidence of small fish tails on the inside of the head. The material of which the two rails are made is wrought iron. None of the oldest inhabitants know when this rail was used. The B. & O. Southwestern is in this vicinity and the Marietta & Cincinnati, its predecessor, was one of the first railroads in Ohio. S. P. BAIRD.



OLD COMPOUND RAIL SECTIONS

Columbus, Ohio.

Criticises Details at Support of Pony Span in Cantilever Bridge

Sir—The rôle of critic is not an enviable one, but the urge that impels a man to want to see progress in his profession is one that is hard to resist. The writer believes that criticism pointing out errors in design that may spell failure of a structure is eminently constructive criticism. One of the most vital essentials of safe design is a proper regard for details. I have many times called attention publicly to common errors of steel structural detail designing. Some of the very errors that I have emphasized are exhibited in an article in your issue of Jan. 16, p. 143, on the Willamette River bridge at Salem, Oregon.

One of the errors referred to, or a nest of them, is at the support of the pony span. In the first place, the line of reaction of the rocker shoe is apparently about 9 in. away from the intersection of the members supporting it. This means that a tremendous bending moment must be carried by these members. The next fault is that the upper one of the two members just referred to has a sharp bend where it has its full stress. By no law of mechanics should a structural member be expected to take its full stress around a bend. Bends should only be employed where there is a properly detailed member to take the resultant stress at the bend.

The other error in this detail is in the lack of adequate support under the rocker shoe. There is a load here which I estimate roughly to be 130,000 lb. for dead load only. There are no stiffeners under the seat of the shoe and a very few rivets under it. The center of gravity of the group of rivets connecting the supporting angles is a wide distance from the center line of the rocker shoe, which means heavy eccentric stress on the rivets. Judging from the number of rivets in the other ends of these members no excess of rivets has been put in to take care of this. On the face of it, the supporting of this heavy load on the feather-edge of these two members, so to speak, is not proper design.

The next fault in details is in the sidewalk bracket in the half cross-section of the deck span. The tension of the upper member of this bracket produces twisting on the top chord of the truss, or, in other words, this tension is not provided for. There ought to be a connection to the top flange of the floorbeam. The bottom member of this same bracket is bent (in the connection plate) where it has its full stress. There is no provision to take the "kick."

The sidewalk bracket shown in the half section of the pony span is also faulty in its connection to the truss. This connection, so far as the drawing shows, is by means of a pair of angles giving excessive tension on the rivet heads, and there is no diaphragm or other member to take the top-flange tension into the floorbeam.

This designer is not alone in these errors. They are all too common. It is for this reason that they ought publicly to be emphasized. EDWARD GODFREY.

Pittsburgh, Penn.

International Language for Modern Engineers

Sir—I have read with much interest the letter in your issue of Jan. 16, p. 156, entitled "International Language for Modern Engineers" and advocating Esperanto as a study for engineers. I hope other engineers will follow it with like recommendations, for I believe there are many in this country who are heartily in sympathy with this idea of using an international language. I note, for instance, that Henry W. Fisher, chief engineer of the Standard Underground Cable Co., is an enthusiastic Esperantist, also that William L. Church, one of the founders of Westinghouse Church Kerr & Co., is another.

The signs of the times point to a steady growth of the use of Esperanto. I know of a $50,000 contract obtained in connection with a reinforced-concrete undertaking that came about through Esperanto. The introduction of Esperanto as a regular feature in the school courses is making decided headway in England; while especially valuable is the testimony that it helps in the study of other languages.

This means that if you would learn to speak Spanish —a year's study—you would make more headway by spending the first three months on Esperanto in order to gain a general language sense than by devoting the entire 12 months to Spanish alone. This argument of Esperanto as a basis for language study bids fair to find general acceptance among the very many who, because they are accomplished in one or more foreign languages, would like to sidetrack any effort to supplant foreign-language study by this international medium.

"Free Masonry for a dollar a year" is an argument with strong appeal. Learn the language and buy an Esperanto directory for a dollar; look up the Esperanto consuls who officially represent the language here, there and everywhere, and see if in traveling for business or pleasure, or even in writing for information, you do not find a hospitality that cannot be estimated in dollars and cents. Experience has shown that the Esperantist, thus using his directory, finds he has friends and information bureaus the world over.

As chairman of the propaganda committee of the Esperanto Association of North America, I am too prejudiced to give much advice. Rather let the advice come from people who are disinterested. I have been at it 12 years and have found my interest steadfast.

G. W. LEE,
Boston, Mass. Librarian, Stone & Webster.

Heavy Counterweight Tested According To Assumptions

Sir—In reference to the article "Proportion Concrete to Weigh 173 lb. per Cubic Foot," in *Engineering News-Record*, of Dec. 26, 1918, p. 1187, attention is called to the following test of an extra-heavy concrete counterweight, in which the added weight was gained by the use of punchings.

The proportions and weights per cubic foot of the materials were:

Cement	0.172 cu.ft. at	94 lb.	=	16 lb.
Sand	0.515 cu.ft. at	95 lb.	=	49 lb.
Aggregate	0.86 cu.ft.			
1. Stone	(0.36 x 0.86) cu.ft. at	98 lb.	=	31 lb.
2. Punchings	(0.64 x 0.86) cu.ft. at	266 lb.	=	146 lb.
Total				242 lb.

With 9 lb. water these weights make 1 cu.ft. of concrete exactly. In the test the weights of the cube were as follows:

Weight day of test	247 lb.
Weight 3 days after	243.5 lb.
Weight 10 days after	242 lb.

No loss in weight after this time.

C. C. NEHER.
United States Engineer Office, San Juan, P. R.

Alaskan Railroad Train Service Maintained Despite Icy Rails

Difficulties of railroad operation in Alaska are apparent from a note in the official weekly publication of the Alaskan Engineering Commission, which describes conditions between Mile 57 and Mile 68 early in December. Despite these adverse conditions service has not been discontinued. This section of the line is low and flat and is affected by the adjoining glaciers. Warm rains, followed by sudden cold weather, made about an inch of ice on the rails in this section and, there being no machinery to remove it, gangs of laborers at a temperature —12 F., worked continuously in relays Saturday, Saturday night, Sunday and Sunday night, picking the ice off the rails ahead of the trains. According to a later issue of the Alaska Railroad *Record* the operating department was not discouraged by this and other troubles along the line, through service being maintained even when dog teams had to be used to transfer mail and passengers across snow-filled gaps.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Awning Reduces Lost Time by Hiding Movements of Derrick

COMPLAINT of an overhead cable tramway was made by the superintendent of a construction job because "the men stopped work to watch the loads go by." On another job a derrick periodically swung its load over the yard where a crew of carpenters was framing forms. A flimsy canvas awning had been stretched over the carpenters' benches. This covering was obviously no protection against falling objects, and no other purpose which it served could be observed. Curiosity prompted inquiry. "Until that awning was put up," replied the contractor, "those carpenters stopped work every time the derrick swung its load and stood ready to dodge if it let go. Now they can't see the load pass and they pay no attention to it. That awning saves 10% lost carpenters' time." Perhaps the saving was overestimated, but the contractor's action was prompted by sound reasoning. Any spectacular construction operation distracts to some extent the attention of every workman within sight of it. If the operation involves an element of danger, its attraction becomes almost irresistible. If in such cases the construction of a screen is practicable at small cost the investment will often be profitable.

Other Articles in This Issue of Interest to Contractors:

Operating a Hydraulic Dredge Under Difficulties — Page 410

Civil War Price Trends Compared With Today — Page 414

The Construction Division of Our Army — Page 416

Dump Cars and Wagons Enlarge Railway Fills — Page 419

Motor-Truck Costs Much Higher Than Generally Assumed — Page 438

How Building Is Promoted in Huntington (Letter) — Page 441

Home-Made Cableway Carrier Operates With Single Hauling Line

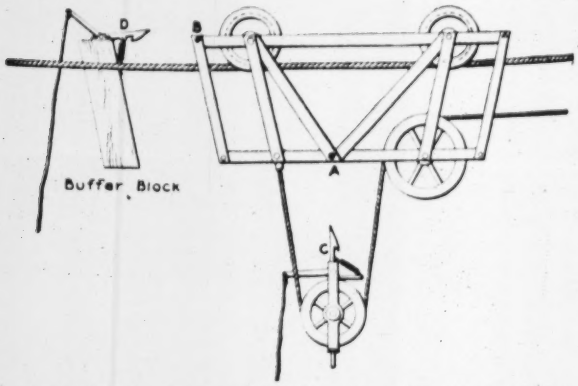
MATERIALS and equipment for the Gibraltar dam near Santa Barbara, Cal., had to be conveyed over a 750-ft. cableway from the end of the industrial railroad track to the dam site. A carrier was devised for this cableway by W. A. Kraner, of Bent Brothers and W. A. Kraner, contractors, and it is operated satisfactorily with a single hauling line. This is made possible by the fact that the cableway is on an incline sufficient to return the carrier by gravity, but there is also an ingenious arrangement of hooks which lock the carrier under certain conditions.

The carrier is made of heavy strap iron, and operates on a 1¼-in. cable. Besides the two main cable wheels which support the frame there are only two other wheels on the carrier. One of these is an idler or guide sheave fixed to the carrier frame and around which the hauling line passes. The other is a sheave around which the hauling line also passes but which is attached to the counterweight and moves with the load to and from the carrier. The end of the ⅜-in. hauling line, after passing around the two sheaves, is attached to the carrier frame.

The interesting features of the carrier are the two hooks which lock automatically. One is attached to the sheave which moves up and down with the load; its function is to lock the load to the carrier so that it cannot come down until desired. The hook projects above the sheave in such a way that as the load is drawn up to the carrier the hook engages a bolt in the frame and is held in place by a steel spring. Thus, even though the hauling line is slacked off, the load would remain suspended from the hook. The hook can be disengaged from the bolt by a pull on the releasing rope which hangs down to the ground. This release can be effected only when the hauling line is taut; afterward, as the hauling line slacks away the load comes down from the carrier.

The second hook is attached to the buffer-block at the lower end of the cableway span. Its function is to engage a bolt in the carrier and hold it stationary on the main cable while the hauling line lifts the load and locks it to the carrier. After this has been accomplished the hauling line is slacked away slightly, and the hook in the buffer block is released by the pulling of a rope which hangs down to the ground. The load is then moved up the cableway by winding up the hauling line. A buffer-block hook is needed at the lower end of the cableway only because the incline of the main cable is not steep enough to cause the carrier to slide down from the upper end when the load is being lowered. However, if the cableway were steeper the addition of a hook in the upper buffer block could hold the carrier in the same way as

CARRIER WITH TYPICAL LOAD



HOME-MADE CABLEWAY CARRIER OPERATES WITH SINGLE HAULING LINE
Hooks C and D automatically engage pins A and B until released by trip ropes

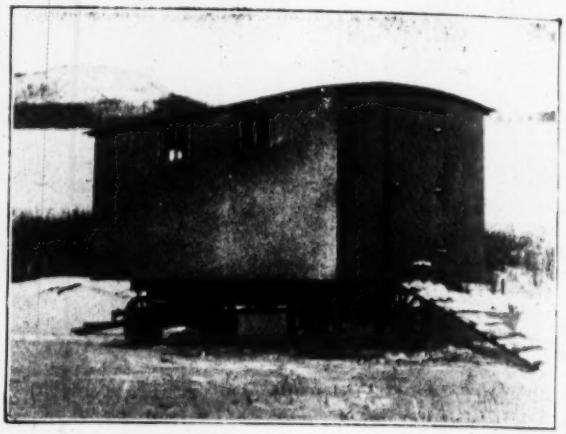
the one at the lower end, and the system would still be automatic. The carrier has given excellent service, it is reported, and has regularly handled 40-sack cars of cement with 6 min. to the round trip. Loads up to six tons have been hauled up with the 25-hp. motor installed for operating the cable.

Car Camps for Road Maintenance Gangs Repay Cost Each Season

CAR camps on wheels with a bunkhouse and mess-hall unit in each outfit repay their cost each season on road maintenance in Gogebic County, Michigan, by reducing lost time of men and wear and tear of camp equipment. An outfit, with a mess-hall unit complete, as illustrated, and an exactly similar bunkhouse unit without furnishings, was built by a local wagon maker for $675.

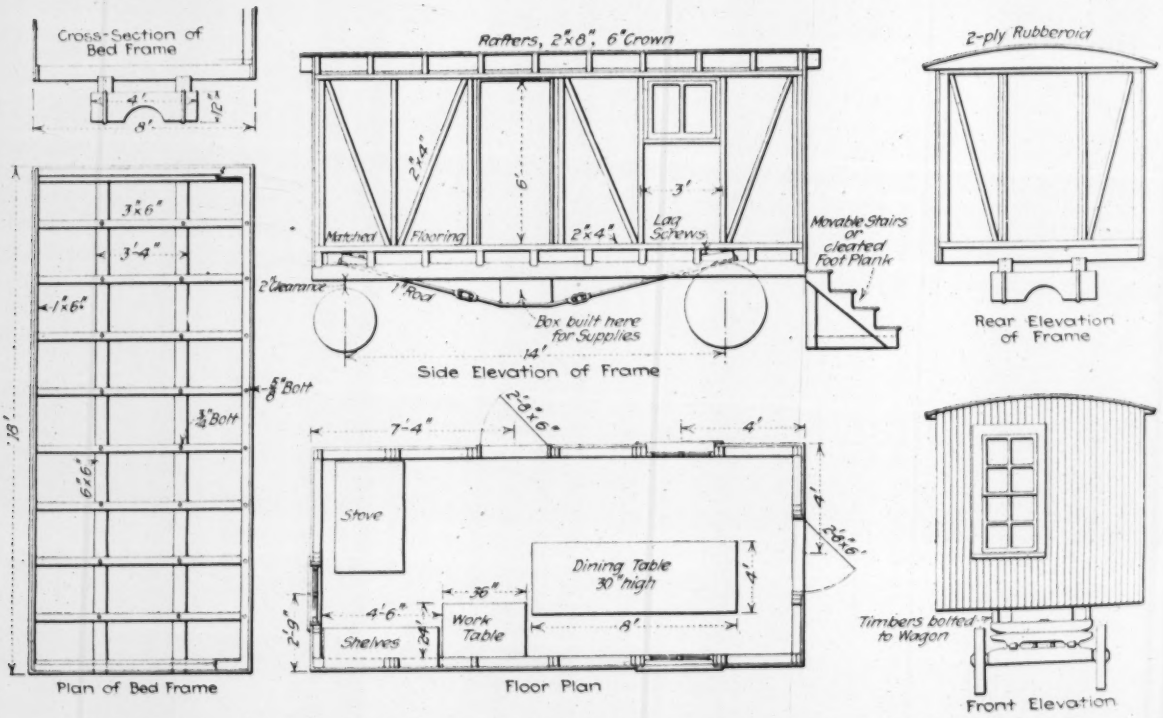
Roads in Gogebic County are long and run through a sparsely settled country. In summer the traffic is heavy. Maintenance, therefore, calls for continuous repairs over long stretches of road. One outfit last season kept a 70-mile road in shape, and the camp was at all times close to the repairs being done. The time lost traveling between camp and work was almost negligible.

The wagons are standard-gear, with $\frac{3}{4}$ x 4-in. tires, $3\frac{1}{4}$ x 12-in. skeins, 28-in. front wheels and 36-in. rear

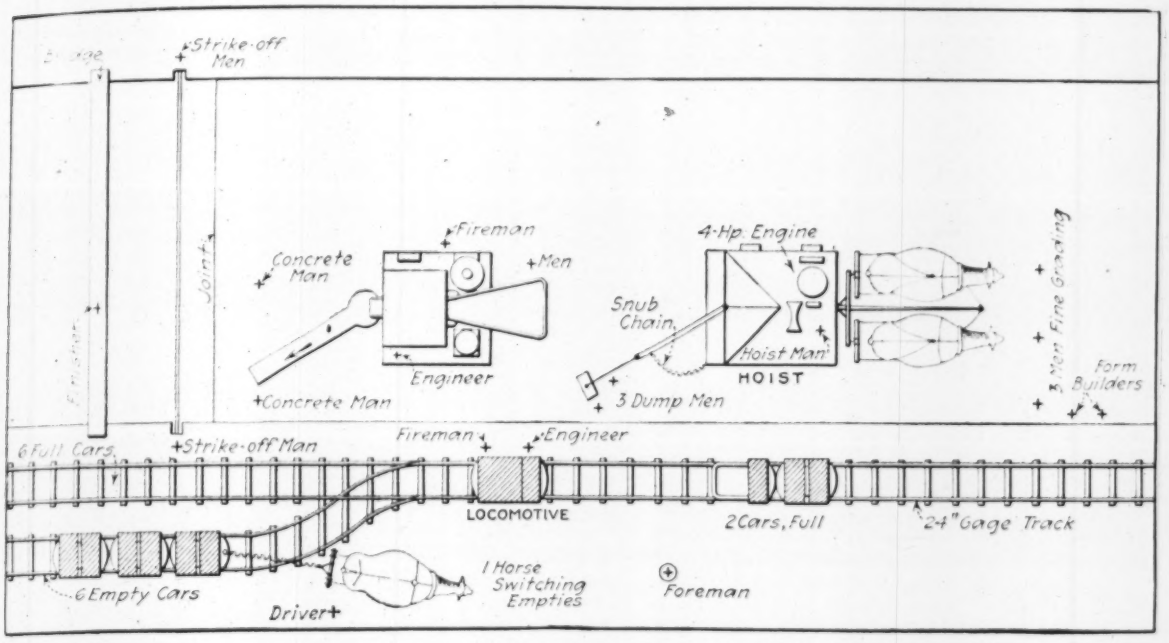


WAGON CAMP UNIT LOCKED AND LAID UP FOR WINTER

wheels. The bolsters are made as wide as possible; in this case they are 40 in., and the front bolster is so arranged that the front wheels can turn under the body as far as the reach. The construction of the wagon house is clearly shown by the drawings of the mess-hall unit. The bunkhouse unit is exactly similar in construction, but is furnished with steel cots. It will accommo-



DETAILS OF WAGON TOP FOR PORTABLE BUNKHOUSE AND MESS HALL ON ROAD REPAIR WORK



LOCATION OF EQUIPMENT AND WORKING FORCE AT MIXER

date cots for 12 men. A 7000-lb. tractor hauls each unit easily. C. F. Winkler, Bessemer, Mich., is the engineer of the board of road commissioners of Gogebic County.

Horse-Drawn Derrick Loads Concrete Mixer

PROPORTIONED batches hauled in buckets on industrial flat-cars were transferred to the mixer by a horse-drawn derrick, in constructing 5557 ft. of concrete road for the extension of Camp Custer. The concrete slab was 18 ft. wide, 8 in. thick at the center, and 6 in. thick at the edges. At intervals, opposite warehouses, the pavement was widened into aprons each 216 sq.yd. in area. One apron was a day's work for the paving gang; on straightaway pavement the maximum day's work was 330 lin.ft. or 660 square yards.

Aggregate brought in railway cars was unloaded by a clamshell into stock piles or elevated bins located about three-quarters of a mile from the job. Industrial flat-cars, each carrying two 120-cu.ft. bottom-dump boxes,

HORSE-HAULED DERRICK HANDLED BATCH BOXES

ran to the bins and received their charges of sand and gravel, then to the warehouse to take the cement, and finally, in five-car trains, were hauled to the mixer by a 3-ton gasoline locomotive. At the mixer the derrick with a 4-hp. gas engine lifted the boxes one at a time and dumped the batches into the mixer. The operations at the mixer are indicated by the drawing.

The Camp Custer extension was built under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greeley, supervising engineer, by the W. E. Wood Co., Detroit, Mich., contractors. D. E. Marsh was division engineer of highway construction.

Extra Screening of Sand Reduces Concrete Costs

EXTRA screens and a sedimentation basin added to the gravel-washing plant at Lockington dam of the Miami Valley flood-protection works are saving $100 a day in the cost of concrete. The washing plant is the standard construction described in *Engineering News-Record* of Oct. 10, 1918, p. 680. At Lockington the sand, as it came from the regular ⅜-in. revolving screen, contained an overproportion of grains of larger size. To increase the fine-grain content of the sand produced, two stationary inclined screens of ¼- or ⅛-in. mesh have been placed underneath the revolving screen, and the water from the revolving screen, instead of being wasted, is led to a settling tank where the fine sand is dropped and the water escapes over a weir. At intervals the fine sand is shoveled from the tank into the sand bins.

By thus screening out the coarse grains and salvaging the fine grains, a concrete sand is being obtained which in lean concrete has reduced the cement required from six to five bags per batch, of 16⅔ per cent. In rich concrete the saving is proportionally greater.

The construction of the Lockington dam is under the direction of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Charles H. Paul, assistant chief engineer, and C. H. Locher, construction manager. B. M. Jones is division engineer.

NEWS OF THE WEEK

New York, February 27, 1919

New Highway Bill Introduced in Congress

Federal Highway Commission and System To Be Established—Presented as Basis for Future Action

A new highway bill, which would establish a Federal highway commission to take charge of building and maintaining a United States highway system, has been introduced in Congress. In introducing the bill into the Senate (as S.5626) Senator Townsend stated that he did not contemplate asking for its passage at this session, but desired that it might be criticised by interested parties to furnish a basis for intelligent action by Congress at the next session

The bill provides for a commission of five members, to be appointed by the President, with the advice and consent of the Senate. Not more than three of the commissioners may be of the same political party, and they must be selected from various sections of the country. In appointing the first commissioners, the President shall designate each man's term as three, four, five, six or seven years, after which vacancies shall be filled for seven-year terms as they occur. The compensation of each commissioner shall be $10,000 per year, and the commissioners shall give their entire time to the work. They shall select a chairman from their number, and the commission is allowed to appoint a chief engineer and a secretary, and employ engineers, special experts, attorneys, clerks, etc., as they may be necessary. All other employees shall be obtained through the United States Civil Service Commission.

In defining the highway system the bill states: "There is hereby authorized to be established, constructed and maintained a system of highways . . . to comprise not less than two main trunk-line roads in each state and joining the national highway system in the adjacent states and countries." It includes necessary bridges, drainage structures, signs, guard rails, etc.

All Government highway agencies are taken over by the commission, and appropriations are provided for carrying on the work as follows: Fifty million dollars, available July 1, 1919; $75,000,000, July 1, 1920; $100,000,000 for each of the three next succeeding fiscal years, or $425,000,000 in all, which shall be available until expended. It is further provided that the Secretary of War, at his discretion, shall deliver to the commission without charge such vehicles, motor vehicles, road-building machinery, and other equipment as are suitable to construct and maintain highways. The Federal-aid law of 1916 is amended to allow wider scope in the interpretation of the words "post roads," and $25,000,000 each for the years 1919 and 1920 is appropriated for Federal aid.

After the general expenses authorized for the commission are deducted, the appropriations shall be divided as follows: One-third in the proportion of the area of the state to the total area of all the states; one-third in the proportion of the population of the state to the population of all the states, and one-third in the proportion of the mileage of highways in the state to the total mileage in all the states.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Meyers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Federal-Aid Highway Appropriation Goes Through

Federal aid for highways received a large addition when the Post-Office appropriation bill went through the Senate carrying $200,000,000 for this purpose. The bill, which was noted in *Engineering News-Record* of Jan. 30, p. 251, now awaits the signature of the President.

The provisions of the bill greatly enlarge the scope of the term "rural post road" to cover roads that either are used or can be used for transportation of the mails. It also increases the maximum payments which the Federal Government can make per mile from the previous amount, $10,000, to $20,000. This will allow the building, in coöperation with the states, of roads costing $40,000 per mile.

Will Attempt to Bring About Lower Prices

Government Commission to Issue Fair Price Lists After Study of Each Commodity

Voluntary and general price reductions will, it is hoped, result from the operation of a new commission which has just been organized by the Department of Commerce in coöperation with the Council of National Defense. The scheme, which was proposed by Secretary of Commerce Redfield, does not involve any regulatory powers of the Government in price fixing, but is intended to bring about reductions in prices through coöperation of capital, labor and the Government and through wide publicity of what the Government considers fair prices.

The commission, known as the Industrial Board of the Department of Commerce, will meet with the representatives of each manufacturing interest and with the representatives of labor and will endeavor, through an adequate presentation of the underlying costs of the commodity involved, to ascertain what should be a fair price for it. This price it will announce with as much publicity as possible. There will be no obligation on any one either to pay or to accept such a price; it will merely be what the Government experts, after an analysis of the situation, consider to be a fair return for all parties involved. It is possible, however, that this price will become the basis for the Government's own purchases in the commodity.

It is hoped by this means to bring about that general, mutual and simultaneous reduction of reward, to all parties who profit by a sale, which is necessary to a gradual price reduction.

The board at present has for members George N. Peck, chairman; Hugh Frayne and Thomas C. Powell. Mr. Peck was vice-chairman of the War Industries Board. Mr. Frayne is a noted labor leader and its representative on the War Industries Board, and Mr. Powell is director of capital expenditures of the Railroad Administration. Three other members will be appointed.

Engineering Council in Annual Meeting Reviews Year's Work

At its second annual meeting in New York, Feb. 20, the Engineering Council voted to appoint a small committee to advise and confer with the Reconstruction Commission of the State of New York. This action was taken in response to a request from Abram I. Elkus, chairman of that commission, which request probably resulted from the letter sent by the Engineering Council to Governor Smith. The executive committee reported on the effect of the hearing called by the Engineering Council in regard to the sudden dismissal of 339 Public Service Commission engineers, and the fact that reinstatement followed. It was also decided to appoint a special committee to consider the classification and salaries of railway and Government engineer employees.

Among the many committee reports one of the most important was that of the Engineering Societies' Employment Bureau, which up to Feb. 15 had 1400 applications for positions and found positions for 200, and to which the national societies have agreed to give larger appropriations.

The new representatives in the Engineering Council are: A. N. Talbot, past president of the American Society of Civil Engineers; J. R. Worcester, consulting civil engineer, of Boston; M. E. Cooley, president of the American Society of Mechanical Engineers, and Albert Ladd Colby, of South Bethlehem, Penn., representing the American Society for Testing Materials. The other members whose terms expired were re-elected. The total number in the council is now 26.

The new officers are: Vice-chairman, E. S. Jacobus, advisory engineer, Babcock & Wilcox Co.; C. S. Churchill, second vice-chairman, vice-president of the Norfolk & Western R.R. The additional members of the executive committee are Comfort A. Adams, president of the American Institute of Electrical Engineers; Philip N. Moore, past president of the American Institute of Mining Engineers; Charles E. Skinner, engineer of the research division, Westinghouse Electric & Mfg. Co. J. Parke Channing and A. D. Flinn were re-elected chairman and secretary, respectively.

Freight Increase in Road Materials Not Contemplated

Recent rumors of a horizontal increase of 30% in freight rates, applying to sand, gravel, crushed stone and slag, are without foundation, according to the Division of Public Works and Construction Development, Department of Labor. Considerable highway construction and other contract work have been held up by the uncertainty, and should now go forward. The Division of Public Works investigated the rumor and was assured by the Railroad Administration that no such raise is contemplated. If these rates are increased in the future, it will be as a part of a general rate increase, which is not proposed at the present time, as shown by the following circular of the Railroad Administration, dated Jan. 20:

"There is no foundation for the report that the Railroad Administration has given, or is giving, any consideration to any increase in the present basis of rates."

President Invites Local Officials To Discuss Reconstruction

Governors of the states and mayors of over 100 cities have been invited to attend a conference at the White House Mar. 3-4 to discuss "vital questions affecting business and labor." The President will address the conference. The Department of Labor, which is promoting the meeting, issued the following statement:

"The conference will take up vital questions affecting business and labor. It is the desire of the President to establish before he returns to Europe a definite nation-wide policy to stimulate public and private construction and industry in general. A large number of officials have already signified their willingness to attend such a conference. Plans will be presented to show that the Federal Government is anxious to coöperate with the various states and municipalities in all efforts to assure continued prosperity in the interests of manufacturers, merchants and wage-workers."

Society Gets Mayoralty Candidates' Promise to Aid Engineers

The five contestants for mayor in the primary election in the City of Chicago, Feb. 25, all answered in the affirmative the following questions put to them by the Chicago Chapter of the American Association of Engineers: "Will you, if elected, fairly investigate the claims of the engineers working for the city to more adequate remuneration?" (The rates have not been changed in 21 years). "Will you appoint no 60-day men without engineering experience to engineering positions?"

Water-Works Improvements for Seattle Authorized

The city council of Seattle has authorized a transfer of $750,000 from the Skagit River hydro-electric fund to the water-works fund for three dams at Swan Lake, and for conduit construction. The Board of Public Works is busy with plans and specifications. The lake will be raised from El. 468 to El. 488, creating a total storage of nearly 80,000,000,000 gal., of which almost 50,000,000,000 gal. will be available through an outlet at El. 455. A 2½-mile tunnel will be driven from the lake to Molasses Creek, and a pipe line will be built from the creek to the city. L. B. Youngs is superintendent of water-works.

Transmississippi Readjustment Congress at Omaha

Some 1200 delegates from 204 cities and towns in 22 states held a Transmississippi Readjustment Congress in Omaha Feb. 19-20.

City officials who attended a section meeting agreed that public improvements should be made without waiting for a fall in prices of labor and materials. The keynote of the section meeting of the contractors and builders was that "the way to resume building operations is to resume." Several speakers were of the opinion that there would be no material fall in prices for months to come. John W. Towle, of Omaha, said, "We should go ahead for the next few months and do business on a very slight margin of profits, or no profits at all."

Resolutions were adopted indorsing the principle of a league of nations; the promotion of public and private work by Federal, state and municipal governments during the readjustment period; Federal reclamation of arid and waste lands in the public domain and the enactment of state laws "whereby the returning soldiers may be given employment in the preparation of such lands for settlement and provided with assistance to make permanent homes when the reconstruction period is passed"; the construction of good roads by Federal, state and local coöperation; partnership instead of enmity between capital and labor; the return of the railroads to their owners, with Government regulation to "prevent the abuses of the past and secure to the public the greatest good to be derived from economic, efficient, coöperative management, eliminating restrictive legislation that has hitherto hampered much-needed improvement"; the development of inland waterways, particularly the Mississippi and its tributaries, the extension of foreign trade and the turning over to private ownership of vessels built by the United States Shipping Board; legislation for "the early development of the water power now going to waste on the public domain," and giving to the people of the West the same right to develop their natural resources as "has already been exercised by the people of the Eastern states"; a Federal budget system; and "the extension of the Americanization campaign so as to include all portions of the country in which foreign influence still prevails."

American Institute of Consulting Engineers Elects Officers

The American Institute of Consulting Engineers elected the following officers at its recent annual meeting: President, L. B. Stillwell, reëlected; vice-president, A. M. Hunt; secretary and treasurer, F. A. Molitor. The following members of council were elected to replace those retiring: S. Whinery, Desmond FitzGerald, and J. Parke Channing.

Sacramento Flood Damage Increases

Heavy rains early in February caused a rise in the Sacramento River sufficient to inundate some 10,000 to 15,000 acres of farm land in the Sutter Basin district south of Marysville, Cal. The continued reclamation of areas along this stream has decreased the local storage capacity so that floods which a few years ago would not have caused material damage are now sufficient to submerge farms that have been heretofore above even the higher flood levels.

The extensive damage of the present flood is thought to be in large measure due to the fact that the west levee of the district was built before the east levee was closed, work being continued meanwhile on the Armour project, known as Reclamation District 1500. A large number of farmers have been flooded out, and the value of the crops lost is estimated to be between $500,000 and $1,000,000. Draining the inundated areas may require cutting the levee at the lower end of the district, and this cannot be done until the river subsides from the present flood stage.

The flood control in the Sutter Basin district is closely identified with the Sutter bypass project, and it has been understood in the court procedure attendant upon the work thus far that temporary inconvenience could be expected during the construction period.

Outlines Policies of American Association of Engineers

President W. H. Finley addressed an open meeting of the American Association of Engineers in New York City an the evening of Feb. 10, following a dinner of the New York chapter in his honor.

In referring to the great change of conditions in the engineering profession during the past quarter century, he pointed out that the schools are now turning out engineers in shoals, and that the profession has hardly found itself yet, but that it is clearly necessary for engineers to associate for the protection of their business relations to the community. The American Association, organized as a business association of engineers, he said, has no desire to take up technical matters, but is willing to leave that to the established societies. Its scheme of organization is to leave the development task to the local chapters, which should be free to work out their destiny without feeling the heavy hand of the national organization extended over them.

Following Mr. Finley, R. S. Parsons, chief engineer of the Erie Railroad Co., spoke entertainingly of the specific mental qualities that characterize the engineer, and of the relationship between these qualities and the ability to direct affairs efficiently. He made an earnest plea for greater participation of engineers in politics and administration.

Secretary of Associated General Contractors of America

G. W. Buchholz, who has been selected as acting secretary of the Associated General Contractors of America, as mentioned in these columns last week, p. 398, has been engaged in general contracting since his graduation from Columbia University, in civil engineering, in 1901. His service has been principally with the Snare & Triest Co. and the North-Eastern Construction Co., both of New York. He has acted in a wide variety of positions both in the field and in the office.

During his connection with the Snare & Triest Co. he was in intimate contact with the following works: The Government coaling station at Frenchman's Bay, Maine; terminal improvement, Williamsburg bridge, New York; Lackawanna Railroad Terminal at Hoboken, N. J., and the Delancey Street subway connection to the Williamsburg bridge. Later he served as works manager of the company's pier work in New York harbor and had charge of the construction of city pier 30, South Brooklyn, N. Y.; Pier 3, Erie Basin; Pier 17, North River, and Pier 8, Weehawken, Erie Railroad.

Chosen to Act as Secretary of General Contractors' Association

G. W. BUCHHOLZ

Shortly after the declaration of war against Germany, Mr. Buchholz was placed in charge of the construction of 36 fire-resisting ammunition-storage buildings for the Navy Department at Lake Denmark, N. J., and Iona Island, N. Y., including the necessary railroad construction to serve them. On Mar. 1, 1918, he joined the forces of Fred T. Ley & Co., Inc., of New York and Springfield, and went to Perryville, Md. as assistant works manager on a contract to construct an ammonium nitrate plant for the Bureau of Ordnance, Atlas Power Co. agents. He later became works manager of this $13,000,000 operation.

William A. Davis, selected to act as organization manager, to assist Mr. Buchholz, was recently connected with the War Labor Board and has been connected with the organizing of the National Association of Manufacturers, the National Association of Marble Dealers and the National Association of Steam and Hot Water Fitters. The association has taken offices in the Conway Bldg., 111 W. Washington Street, Chicago, Ill., which will be its headquarters, with a branch office in New York at 225 Fifth Ave., until May 1.

Navy Sells Material By Bids

Such surplus material as the Navy Department has will be sold through the usual sealed bids and not by a sales organization such as has been organized in the War Department. The amount of Navy surplus, however, is very small compared to that of the Army.

England Will Subsidize Home Building

Dispatches from England state that the British Reconstruction Ministry has offered to rebate 75% on the loss on homes built now if the property has decreased in value at the end of five years.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 910 Michigan Ave., Chicago; Mar. 18-20; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

The Detroit Engineering Society held a meeting Feb. 21 which was devoted to a discussion of the measurement of the flow of liquids and gases by means of the Pitot tube. L. D. Royer, power and construction department, Ford Motor Co., delivered the address. The meeting was held jointly with the Michigan Chapter of the American Society of Heating and Ventilating Engineers.

The Michigan Engineering Society will hold a special meeting at Ann Arbor Feb. 28 for the purpose of reorganizing.

The Montreal Branch of the Engineering Institute of Canada will be addressed Mar. 6 by N. M. Campbell, who will speak on "Air Drills," and by Dr. Howard Bronson, who will read a

paper on "The Halifax Explosion from a Chemist's and Physicist's Viewpoint." A motion picture of "Burroughs Adding Machines," by the Burroughs Adding Machine Co., will be shown.

The Rochester Engineering Society will hold a meeting Feb. 28 at which Samuel W. Miller, president of the Rochester Welding Works, will speak on "Heat Treatment of Steel."

The Engineers' Club of Baltimore was addressed by C. J. Blanchard of the United States Reclamation Service at a recent meeting. Mr. Blanchard spoke on the work being done by the Government in reclaiming 2,000,000 acres and the establishment of homes for 3500 families, in the light of the plan of the Department of the Interior for returned soldiers.

The San Francisco Association of Members of the American Society of Civil Engineers held a special meeting Feb. 12, which was addressed by Maj. John D. Galloway, past president of the association, just returned from more than a year's service in France. Major Galloway was on duty at General Headquarters of the Army in the Intelligence Section, and gave an interesting illustrated talk on the information obtained from the enemy about troop movements and location and capacity of transportation facilities. He also showed a series of charts with which he reviewed the progress and important elements of the chief battles of 1918.

The Engineers' Club of Trenton Feb. 24 inspected the works of the Mercer Automobile Co. An opportunity was afforded by the automobile company for the inspection of every detail of the manufacturing process.

The National Fire Protection Association will hold its 23rd annual meeting May 6-8 in Ottawa, Ont.

The Cleveland Engineering Society was addressed Feb. 18 by J. C. Beardsley, Thompson Meter Co., New York, who read a paper on "The History of Water-Supply."

The Albany Society of Civil Engineers held a meeting Feb. 25 at which Col. C. G. Mettler, U. S. A., spoke on "Making Cannon at the Watervliet Arsenal."

The Engineers' Club of Philadelphia will hold a regular meeting Mar. 13. Dr. John A. Brashear will present an illustrated paper entitled "An Evening's Journey Among the Stars." On Mar. 12 the club will hold a special meeting, which will be addressed by Prof. Warren P. Laird, of the department of architecture, University of Pennsylvania, who will present an illustrated paper on "The Placement of the Delaware River Bridge." Professor Laird's paper will deal exclusively with the problem of the location of the bridge as a public utility, without going into matters of construction and finance. At the weekly luncheon Mar. 4 Alfred D. Flynn, secretary of the Engineering Council, will speak on "Joint Activities of Engineers; a Résumé of the Work of the Engineering Council and the Engineering Foundation."

The Nebraska Engineering Society will hold its annual meeting at the University of Nebraska, at Lincoln, Mar. 11. It will consider bills presented by its legislative committee to the present legislature designed to improve the position of the county surveyor by establishing as "official" only surveys made by county surveyors, state surveyors and Government surveyors. It will also consider the engineers' license bill, motor-vehicle license bill, state highway system bill and the one-mill state-aid road fund. In connection with this meeting there will be held the second annual Nebraska Road Institute, at the University, Mar. 10-14. The subjects will include the new road laws, road construction and road surveys. A visit will be paid to the Lancaster County roads now being built. Clark E. Mickey, University of Nebraska, is president of the Nebraska Engineering Society and chairman of the Nebraska Road Institute.

The Seattle Association of Members of the American Society of Civil Engineers elected the following officers at the recent annual meeting: President, L. M. Grant; vice-president, John L. Hall; secretary and treasurer, Philip A. Franklin.

The Duluth Engineers' Club passed a resolution, at its monthly meeting Feb. 20, authorizing the president of the club to appoint a civic relations committee of six members for the purpose of taking an active part in municipal projects. A resolution was passed in favor of the proposed appropriation of $50,000 a year by the State of Minnesota to complete the topographical survey.

The Pittsburgh Chapter of the American Association of Engineers has elected the following officers for the year: President, C. K. Harvey; vice-president, H. C. McCormack; secretary, H. Gellin.

PERSONAL NOTES

LIEUT. ARCH. W. NANCE has received his discharge from the Army and has returned to his work with the Farris Engineering Co., constructing engineers, Pittsburgh.

EDWARD R. BOWEN, formerly of the firm of Lippincott & Bowen, consulting engineers, has opened offices in the Central Building, Los Angeles, Cal., to specialize in water-supply and irrigation work.

CAPT. CHARLES A. FRENCH, Construction Division, U. S. A., has received his discharge from the service and has resumed his duties as city engineer and superintendent of public works of Laconia, N. H. He was in charge of utilities at the United States Army General Hospital No. 19, at Oteen, N. C.

COL. W. P. ANDERSON, C. M. G., C. E., chief engineer of the Canadian Department of Marine since 1891, is retiring from that position. He entered the service of the department in 1874. Colonel Anderson is a member of the Light House Board, which has recommended that his connection with that body be continued in view of his knowledge of navigable waters.

E. W. HAMMOND, division engineer, Buffalo, Rochester & Pittsburgh R.R., with headquarters at Du Bois, Penn., has been appointed city engineer of Summit, N. J., and will take office between now and the first of May.

GEORGE W. BORDEN, county engineer of Klickitat County, at Goldendale, Wash., has resigned to become construction engineer for Trout Lake Improvement District No. 3, recently organized to construct a concrete road from Trout Lake to White Salmon and Underwood.

MAJ. A. C. EVERHAM, Construction Division, U. S. A., has received his discharge from the service and has been appointed Western contract manager, Raymond Concrete Pile Co., with headquarters in Chicago.

CHARLES G. EDWARDS, assistant chief engineer of the Maryland Public Service Commission, has been appointed chief engineer, succeeding Charles G. Phelps, whose death was noted in *Engineering News-Record* of Dec. 26, 1918, p. 1203.

B. L. CROZIER has been appointed assistant engineer, Paving Commission of Baltimore.

LIEUT. JULIAN MONTGOMERY, U. S. A., formerly office engineer, Texas State Highway Department, has received his discharge from the service and has returned to the Highway Department as division engineer in charge of southern Texas.

WILLIAM F. STROUSE, Baltimore, has been appointed assistant chief engineer of the Maryland Public Service Commission, succeeding Charles G. Edwards, appointed chief engineer, as noted elsewhere.

CAPT. R. MCC. BEANFIELD, topographical officer, Eighth Mounted Engineers, U. S. A., has received his discharge from the service and has entered the service of the Emergency Fleet Corporation as engineer, shipyard plants division, with headquarters in Philadelphia.

LIEUT. EDWARD T. JONES, Engineers, U. S. A., who was engaged in water-supply work on the staff of the chief engineer, Advanced Section, American Expeditionary Forces, has

returned to this country and has received his discharge from the service. He has resumed his duties as chief engineer, Stevens & Thompson Paper Co., Greenwich, N. Y.

LIEUT. JOHN MACMILLAN, Engineers, U. S. A., formerly city engineer of South Pasadena, Cal., who was recently discharged from the service, and C. R. SUMNER, consulting engineer of Los Angeles, have become associated as partners in the practice of civil engineering, with offices in the H. W. Hellman Building, Los Angeles.

LIEUT. COL. L. E. CURFMAN, 314th Engineers, 89th Division, has just returned from overseas and has resumed his former position as city engineer of Pittsburg, Kan.

LIEUT. HOMER G. OLMSTED, Engineers, U. S. A., formerly located at Camp A. A. Humphreys, Virginia, was recently discharged from the service, and has opened offices at Newkirk, Okla., for the practice of engineering, specializing in reports on oil properties.

LIEUT. JOHN T. CHILDS, Sanitary Corps, U. S. A., has been discharged from the service and has returned to his former position with the Rochester Bureau of Municipal Research, to continue his work in connection with the local sanitary services of street cleaning and collection.

CHARLES K. TUCKER, Morgantown, W. Va., has removed to Pittsburgh and has entered the office of the United States Engineer.

ALFRED M. BARRETT, Flushing, N. Y., has been appointed superintendent of highways of Queens County.

MAJ. H. M. MONTGOMERY, previously constructing quartermaster and disbursing officer at Government warehouses and waterworks at Jeffersonville, Ind., and the clothing warehouse at St. Louis, has received his discharge from the service and has become city engineer of Evanston, Ill.

E. N. FLOYD has been appointed supervisor of fire protection of the newly organized Bureau of Fire Prevention, Cleveland, Cincinnati, Chicago and St. Louis Ry., Cincinnati Northern R.R., and Louisville & Jeffersonville Birdge & Railroad.

LIEUT. W. H. FRANKLIN, Construction Division, U. S. A., has received his discharge from the service and has returned to the James Black Masonry & Contracting Co., of Seattle.

HENRY J. BURK, formerly county surveyor of Imperial County, California, has been appointed to the newly created position of city engineer of Holtville, Cal., to undertake surveys and the establishment of street lines and grades.

ALAN T. FRASER, district engineer, Western District, Canadian Northern Ry., previously division engineer at Edmonton, Alta., has been appointed chief engineer, Western Lines, Canadian Nationals Rys., with office at Winnipeg, Man. He was born in 1872 and was graduated from the School of Practical Science of Toronto in 1892, after which he entered railroad service as a rodman, later becoming assistant engineer. He served as resident engineer, Ontario & Rainy River Ry. at Port Arthur, Ont., and was also locating engineer for the Canadian Northern and assistant district engineer of the National Transcontinental before he became division engineer for the Canadian Northern.

JAMES B. HAYS, of F. C. Horn and James B. Hays, engineers and constructors, Boise, Idaho, will continue the business of the firm, following the death of Mr. Hays, noted elsewhere.

Civil Service Examinations

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month; Class B (six years' responsible charge) $185 to $225; Class C (eight years' responsible charge) $230 to $250 a month. Apply to United States Civil Service Commission, Washington, D. C., or to local office of commission for form 1312, and file before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission for form 1312, to be filed in time to arrange for examination at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission for form 1312, to be filed before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission for form 1312, to be filed before Apr. 1.

OBITUARY

RUFUS CAMERON HUNT, civil engineer and contractor, of Washington Court House, Ohio, died in Bowling Green, Ky., Feb. 18, at the age of 68. Mr. Hunt had been engaged in railroad work in this country and in China and South America since 1874, when he was employed by the Cumberland & Ohio R.R. A few years later he served as assistant engineer and resident engineer on contsruction work for the Cincinnati Southern Ry., and in 1881 became chief engineer of the Ohio Southern R.R., in charge of operating and construction work. From 1881 to 1891 he served as resident engineer and division engineer for the Louisville & Nashville R.R. and the Ohio River R.R. He afterward was employed as engineer for the Bessemer Iron & Steel Co., in charge of the construction of blast furnaces, and later went into the contracting business. After a brief employment with the Washington County R.R., Maine, as division engineer, he served two years in China as assistant engineer to William Barclay Parsons on the survey for 750 miles of railroad. During the following two years he was engaged as engineer and manager for the James P. McDonald Co. in mining and construction work in the Andes Mountains in Ecuador, Bolivia and Peru. Later he was connected with subway construction in New York City and with the construction of the Cumberland Mountain cutoff of the Baltimore & Ohio Railroad.

BRIG. GEN. JAMES F. MCINDOE, formerly colonel, Corps of Engineers, U. S. A., died in Tours, France, Feb. 6. He was born in 1868 and was graduated from West Point in 1891. For five years previous to 1913 he was stationed at Portland, Ore., with the rank of major, as United States engineer of the Portland District. In 1913 he was ordered to Manila, P. I., to assume charge of fortification construction, and was afterward transferred to Kansas City, Mo., where he was engaged in Missouri River work at the outbreak of the war.

F. C. HORN, of F. C. Horn and James B. Hays, engineers and constructors, Boise, Idaho, died Feb. 16, at the age of 57. In 1890 he was engaged in construction work in connection with the Chicago Drainage Canal project. He remained in the Chicago district until 1900, when he became assistant engineer on the construction of the Swan Falls power plant on the Snake River, Idaho. In 1905 he was employed by the United States Reclamation Service in the building of Minidoka dam and the Boise River dam.

RICHARD KEATINGE, for many years in the contracting business on the Pacific Coast, died at Los Altos, Cal., Feb. 13. His first connection with the contracting business was in the service of Ernest L. Ransome during the late '80's, from which time he was actively engaged in construction work in the West, erecting many of the concrete buildings in San Francisco. He had also been engaged in hydraulic work.

Shipping Board Reduces Cost of Tracings

Mechanical Reproductions Hard to Distinguish From Originals—Cost But Fraction of Latter

By means of a recently patented process, the Emergency Fleet Corporation has been producing, at a cost of from 10 to 13c. per square foot, tracings which, if made by hand, would ordinarily cost from $1.50 to $5 per square foot. The resulting tracings from this process are so nearly like the original that they are distinguishable as reproductions only on close inspection.

The accompanying table shows the amount of tracings delivered and the cost for the week of Dec. 5 to 12, 1918. A similar table submitted for the week of Oct. 17 to 24, 1918, shows 1137 sq.ft. at a cost of 12.9c per square foot. Besides the simple operation of reproducing tracings either on cloth or paper, the process has been used in a

WEEKLY REPORT OF LITHO ROOM, DEC. 5-12, 1918

Number of men in room	2
Original tracings received	417
Process tracings made	1681
Number of plates of jelly poured	36
Number of square feet of tracing cloth used	2566
Number of square feet of tracing cloth delivered	2460
Number of square feet of tracing cloth wasted	106

Approximate Expense of Section for Seven Days

Cost of tracing cloth	$137.25
Miscellaneous supplies and jelly	29.00
Supervision	60.00
Labor	46.00
Total Expense	$272.25

Approximate Cost per Square Foot

Labor per square foot	$ .019
Materials and supervision	.093
Total Cost	$ .112

number of other ways and for a variety of purposes. It has been used for progress work, the reproductions, either on cloth or strong paper, being used instead of blueprints or Vandykes. It has also been used to produce new drawings, a large part of which are similar to those previously made, by blocking out the parts to be changed on either the transfer print or on the plate, with the new details drawn in by hand.

The work is done in the following manner: A matrix blueprint on a special transfer paper is made on any good blueprint apparatus, but it is not developed or washed before its use in the process.

When at the proper temperature a sensitized gelatine is pourned over a zinc plate, usually 42 x 98 in., or 42 x 110 in., which rests on an inclined, adjustable table, proper thickness of gelatine being obtained by the angle of inclination of the table and by the special pouring pot designed for the process. The overflow is caught and used again. As soon as the gelatine is poured, the table is righted and the gelatine allowed to set a few minutes.

From the adjustable table the gelatinized plate is put into a recess of a patented refrigerating table and undergoes the essential treatment on which the success of the process depends.

After a few minutes in the refrigerator the plate is placed, gelatine up, on the refrigerated top of the table, its temperature being maintained at the 60° limit of efficiency. The unwashed matrix print is laid face down on the gelatine for a few seconds, which, on removal, leaves the reversed image on the gelatine, a reaction having taken place between the unexposed lines of the transfer-print and the sensitized gelatine.

The gelatine plate is then inked with a squeegee roller spread with special carbon ink, which clings only to the lines left by the transfer-print reaction, being repelled by the rest of the gelatine.

The paper or cloth on which the tracing is desired is then laid smoothly on the gelatine, pressed flat and immediately taken off, the complete tracing being transferred to the finest line. As many as 10 to 15 impressions may be made on tracing cloth from one gelatine plate, merely by re-inking, and 40 to 60 copies reproduced on paper. The finished tracing is then complete, and can be used within a short time.

The time from the transfer print to the finished tracings was 30 min. or less. Pouring and refrigeration of plates are so controlled that no delay occurs at any stage of the process, and although the stated limit of capacity for a one-table plant is 500 sq.ft. a day, actual results, as shown by the table, have been greater than this.

New Locomotive Crane Developed by Construction Company

In the prosecution of heavy construction work, the Terry & Tench Co., Inc., of New York City, found it impossible during the recent emergency, to purchase in the open market hoisting and other machinery heavy and strong enough to answer the demands of the work they had on hand. They solved the problem by designing and manufacturing their own equipment. A locomotive crane is the latest product of this program.

After the needs and experience of the company were incorporated into the design of the various plants, their use in the field created a demand from other contractors in similar lines. To supply this demand, the Edward F. Terry Manufacturing Co. was organized and is building shipyard and locomotive cranes, steel derricks, erectors' tools, etc. This company, although associated with the Terry & Tench Co., does all of the manufacturing, the Terry & Tench Co. confining itself strictly to construction work. This will correct the impression given in *Engineering News-Record* of Jan. 16, 1919, pp. 136 and 137, in which it was stated that the traveling cranes described are of Terry & Tench manufacture.

The locomotive crane mentioned above carries out the results of experience on the work of the Terry & Tench Co. in a number of ways, among which are that all clutches of large size and of inside-band-brake type, and levers operating the clutches are balanced so that the mechanism is free from eccentricity and unbalanced thrusts, thereby making the work of shifting easy and reducing to a minimum the wear of these important parts. The turntable is prevented from tipping by the use of rollers bearing against the under side of the base ring, rather than by the center pin, as is the usual practice. The boom-hoisting drum is driven by means of a train of spur-and-bevel gears, eliminating the friction of the worm gear ordinarily used, so that the boom may easily be raised with full load on the hook. The boom-hoisting drum is equipped with an automatic holding and lowering brake of the inside-band-type, whereby the boom is positively held in position and is under complete control of the operator at all times, and the brakes for the main drums are so arranged that the speed of operation and safety are increased by means of a device which allows the load to be hoisted while the brake is set.

BUSINESS NOTES

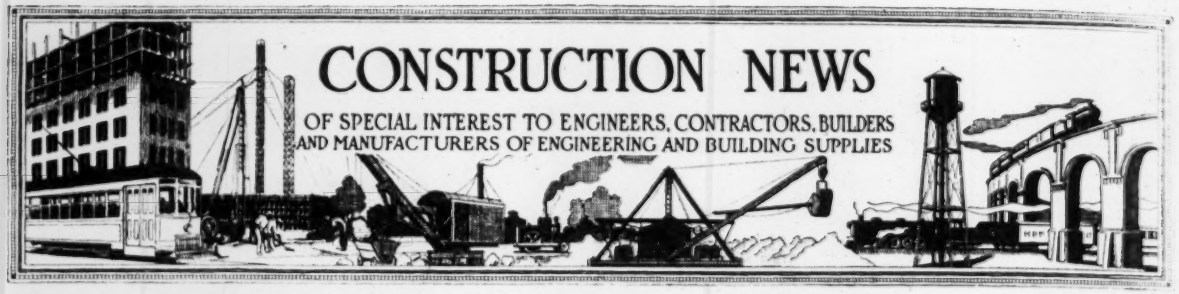
The W. L. Goeltz Co., Inc., engaged in industrial engineering and building, announces that on account of the increasing demand for its "Unit Construction" it is compelled to seek larger quarters. The company is now in its new offices at 150 Nassau St., New York City.

F. A. Putt, formerly with the Clyde Iron Works and the General Electric Co., has become manager of the equipment department of Edward Jobbins, Marquette Bldg., Chicago, handling railway, power and contractors' equipment and supplies.

The Barber Greene Co. of Aurora, Ill., announces the engagement of W. A. Buell, formerly conveyor engineer of the Goodyear Tire and Rubber Co., as sales engineer, and of H. W. Cudding, formerly general auditor of the Lyon Metallic Mfg. Co., as auditor.

The Con-Oil Tank Co. announces the opening of its Pittsburgh office, at 1215 Fulton Bldg., to facilitate the construction of concrete tanks in the Pittsburgh district. The company specializes in the construction of oil and water tanks.

The Wallace & Tiernan Co., Inc., 349 Broadway, New York City, manufacturer of "W. & T." chlorinating apparatus, has appointed David Morey, Jr., as its Southwestern representative with offices at 507 Scollard Building, Dallas, Tex.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages 65-69 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 7	Pembroke, Ont.	Feb. 6
Mar. 10	Junction City, Kan.	Feb. 27
Mar. 10	Underwood, N. D.	Feb. 27
Mar. 18	Wyandotte, Mich.	Feb. 20
Mar. 25	Jersey City, N. J. Adv. Feb. 27.	Feb. 20

SEWERS

Mar. 3	Phillipsburg, N. J.	Feb. 27
Mar. 3	South Orange, N. J.	Feb. 27
Mar. 4	Buffalo, N. Y.	Feb. 27
Mar. 5	Detroit, Mich.	Feb. 27
Mar. 10	Durham, N. C.	Feb. 27
Mar. 10	Underwood, N. D.	Feb. 27
Mar. 14	Trenton, N. J.	Feb. 27

BRIDGES

Mar. 3	Bisbee, Ariz.	Feb. 6
Mar. 4	Lewisburg, W. Va. Adv. Feb. 13 to 27.	Feb. 20
Mar. 5	Holdenville, Okla.	Feb. 20
Mar. 10	Walkerton, Ont.	Feb. 27
Mar. 11	Falls, Pa.	Feb. 27
Mar. 15	Charleston, Miss.	Feb. 27
Mar. 15	Montreal, Que.	Feb. 27
Mar. 20	Springfield, Mass. Adv. Feb. 27.	Feb. 27
Mar. 23	Buckhannon, W. Va.	Feb. 13
Apr. 16	Ottawa, Ont.	Feb. 20

STREETS AND ROADS

Mar. 3	Indianapolis, Ind.	Feb. 6
Mar. 3	**Marshall, Minn.**	**Feb. 13**
Mar. 3	Portsmouth, Va.	Feb. 20
Mar. 3	Charleston, Miss.	Feb. 20
Mar. 3	Alexandria, La.	Feb. 27
Mar. 3	Sumterville, Fla.	Feb. 27
Mar. 3	Eutaw, Ala.	Feb. 27
Mar. 3	Coffeeville, Miss.	Feb. 27
Mar. 3	Lingwich, Que.	Feb. 27
Mar. 4	New Cumberland, W. Va.	Feb. 27
Mar. 4	Davenport, Ia.	Feb. 27
Mar. 4	Roundup, Mont.	Feb. 27
Mar. 4	Hoboken, N. J.	Feb. 27
Mar. 4	West Orange, N. J.	Feb. 27
Mar. 4	De Kalb, Miss.	Feb. 20
Mar. 4	Augusta, Ga. Adv. Feb. 13 and 20.	Feb. 20
Mar. 4	Ripley, W. Va.	Jan. 23
Mar. 4	Indianapolis, Ind.	Feb. 6
Mar. 5	Alexandria, Minn.	Feb. 6
Mar. 5	San Diego, Cal.	Feb. 20
Mar 5	Brooklyn, N. Y.	Feb. 27
Mar. 5	Rhode Island	Feb. 27
Mar. 5	Mt. Holly, N. J. Adv. Feb. 27.	Feb. 27
Mar. 6	Kenosha, Wis.	Feb. 27
Mar. 6	Fairmont, W. Va. Adv. Jan. 30 to Feb. 20.	Feb. 6
Mar. 7	Eldorado, Ill. Adv. Feb. 13 to 27.	Feb. 20
Mar. 7	Webster Springs, W. Va.	Feb. 27
Mar. 8	Indiana	Feb. 27
Mar. 8	Lincoln, Neb.	Feb. 27
Mar. 10	Lafayetteville, W. Va. Adv. Feb. 27.	Feb. 27
Mar. 10	Mt. Vernon, O. Adv. Feb. 20 and 27.	Feb. 27
Mar. 10	Indiana	Feb. 27
Mar. 10	Salem, N. J. Adv. Feb. 27.	Feb. 27
Mar. 10	Clifton, Ariz.	Feb. 27
Mar. 10	Selma, Ala.	Feb. 27
Mar. 10	New Iberia, La.	Feb. 20
Mar. 11	Eutaw, Ala.	Feb. 27
Mar. 11	Buffalo, N. Y.	Feb. 27
Mar. 11	Michigan	Feb. 27
Mar. 12	Baltimore, Md. Adv. Feb. 27.	Feb. 27
Mar. 15	Atlanta, Ga.	Feb. 27
Mar. 17	Riverside, Cal.	Feb. 27
Mar. 18	Santa Ana, Cal.	Feb. 27
Mar. 18	St. Louis, Mo.	Feb. 27
Mar. 18	Kansas City, Mo.	Feb. 27
Mar. 18	St. Louis, Mo.	Feb. 20
Mar. 22	Oregon	Feb. 27
Mar. 31	Lockport, N. Y.	Feb. 6
Mar. 31	Ottawa, Ont.	Feb. 27
Apr. 7	Moulton, Ala.	Feb. 20

EXCAVATION AND DREDGING

Mar. 4	Garner, Ia.	Feb. 20
Mar. 4	Vermilion, S. D.	Feb. 27
Mar. 5	Marshall, Minn.	Feb. 27
Mar. 10	Marks, Miss.	Feb. 27
Mar. 10	Waseca, Minn.	Feb. 27
Mar. 11	Harrisburg, Ark.	Feb. 27
Mar. 11	Rochester, N. Y. Adv. Feb. 13 to 27.	Feb. 20
Mar. 13	Tyler, Minn.	Feb. 6
Mar. 19	Carthage, Ill.	Feb. 20
Mar. 19	Quincy, Ill.	Feb. 20
Mar. 20	Osceola, Ark.	Feb. 27
Apr. 8	Hollandale, Miss.	Feb. 13

INDUSTRIAL WORKS

Mar. 4	Thiells, N. Y.	Jan. 16
Mar. 5	Baltimore, Md.	Feb. 20
Mar. 10	Hibbing, Minn.	Feb. 27
Mar. 19	Brooklyn, N. Y.	Feb. 20
Mar. 20	La Crosse, Wis.	Feb. 20
Apr. 1	Sioux City, Ia.	Jan. 16

BUILDINGS

Mar. 3	Center, Colo.	Feb. 27
Mar. 3	Rockport, Ill.	Jan. 23
Mar. 3	Brooklyn, N. Y.	Feb. 20
Mar. 4	Utica, N. Y. Adv. Feb. 20.	Feb. 13
Mar. 4	Wards Island, N. Y.	Feb. 13
Mar. 4	Winnipeg, Man.	Feb. 20
Mar. 10	Chicago, Ill.	Feb. 27
Mar. 14	Humboldt, Ariz.	Feb. 20
Mar. 14	Dallas, Tex.	Feb. 20
Mar. 15	Baton Rouge, La.	Feb. 27
Mar. 15	Culver, Ind.	Dec. 26
Mar. 15	Duluth, Minn.	Feb. 13
Mar. 17	Johnstown, Pa.	Feb. 20
Mar. 18	Esquimalt, B. C.	Feb. 20
Mar. 18	Esquimalt, B. C.	Feb. 27
Mar. 25	Bath, N. Y.	Feb. 27
Mar. 28	West Unity, O.	Feb. 27
Apr. 2	New York, N. Y.	Jan. 23
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6

FEDERAL GOVERNMENT WORK

Mar. 1	Earthwork—New Orleans, La.	Feb. 27
Mar. 3	Barracks—Spec. 3733—San Diego, Cal.	Feb. 13
Mar. 3	Hospital—Baltimore, Md.	Feb. 13
Mar. 3	Post Office—Walden, N. Y.	Feb. 6
Mar. 3	Sidewalks — Washington, D. C.	Feb. 20
Mar. 3	Grandstand and Bleachers —Spec. 3795—Norfolk, Va.	Feb. 27
Mar. 3	Grandstand and Bleachers —Spec. 3795 — Hampton Roads, Va.	Feb. 27
Mar. 6	Paving — Washington, D. C.	Feb. 27
Mar. 7	Lavatory Annexes — Shiprock, N. M.	Feb. 13
Mar. 7	School and Assembly—Hall —Wahpeton, N. D.	Feb. 13
Mar. 10	Argon Production Plant — —Spec. 3800—North Ft. Worth, Tex.	Feb. 20
Mar. 10	Structural Shop—Spec. 3691 —Mare Island, Cal.	Feb. 20
Mar. 10	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Feb. 13
Mar. 10	School and Assembly Hall—Rapid City, S. D.	Feb. 20
Mar. 10	Condensers—Spec. 3797 — Washington, D. C.	Feb. 27
Mar. 11	Dredging — Philadelphia, Pa. Adv. Feb. 6 to 27.	Feb. 13
Mar. 12	Enlarging Levees — St. Louis, Mo. Adv. Feb. 13 to 27.	Feb. 20
Mar. 12	Boathouse, etc.—Charlotte, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Mar. 14	Hoistway, etc. — Easton, Pa. Adv. Feb. 27.	Feb. 27
Mar. 15	Dredging, etc.—Nome, Alaska Adv. Feb. 27.	Feb. 27
Mar. 17	Wooden Pier and Approach — Spec. 3820 — Yorktown, Va.	Feb. 27
Mar. 17	Building—Spec. 3760—Annapolis, Md.	Feb. 27
Mar. 19	Post Office, etc., Woodward, Okla.	Feb. 20
Mar. 24	Dredging — Wilmington, Del. Adv. Feb. 27.	Feb. 27
Mar. 25	Remodeling Post Office, etc. —Providence, R. I.	Feb. 27
Mar. 31	Coal—Memphis, Tenn. Adv. Feb. 27.	Feb. 27

MISCELLANEOUS

Feb. 28	Tractors — New York, N. Y.	Feb. 27
Mar. 3	Dock—Seattle, Wash.	Feb. 20
Mar. 3	Miscellaneous Supplies — Hamilton, Ont. Adv. Feb. 13 and 20.	Feb. 20
Mar. 3	Riprap—Shakopee, Minn.	Feb. 20
Mar. 4	Road Material — Newark, N. J.	Feb. 20
Mar. 5	Seawall—Detroit, Mich.	Feb. 27
Mar. 5	Road Oil and Tar—Clayton (St. Louis P. O.), Mo.	Feb. 20
Mar. 6	Stone and Screenings—New York, N. Y.	Feb. 27
Mar. 6	Cocks—New York, N. Y.	Feb. 27
Mar. 8	Pipes—York, Ont.	Feb. 27
Mar. 10	Elevated Roadway — Portland, Ore.	Feb. 27
Mar. 11	Miscellaneous Supplies — Newark, N. J.	Feb. 27
Mar. 14	Electric Fixtures—Hudson, N. Y.	Feb. 27
Mar. 14	Radial Chimney — Sarnia, Ont.	Feb. 27

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

N. Y., New Rochelle—City retained Gannett, Seelye & Fleming, engrs., 204 Locust St., Harrisburg, Pa., to make investigations and report on value, needed improvements, etc., of New Rochelle Water Co.